NEW TECHNOLOGIES IN RAILROAD SAFETY AND SECURITY

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RAILROADS

OF THE

COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

HOUSE OF REPRESENTATIVES

ONE HUNDRED NINTH CONGRESS

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NEW TECHNOLOGIES IN RAILROAD SAFETY AND SECURITY

Thursday, April 28, 2005

HOUSE OF REPRESENTATIVES, COMMITTEE ON TRANSPORTATION, SUBCOMMITTEE ON RAILROADS AND INFRASTRUCTURE, WASHINGTON, D.C.

The subcommittee met, pursuant to call, at 10:05 a.m., in Room 2167, Rayburn House Office Building, Hon. Steve LaTourette [chairman of the subcommittee] presiding.

Mr. LATOURETTE. Good morning. The hearing of the Railroad Subcommittee will come to order.

I want to welcome all of our members and our witnesses here today, the first meeting of the Railroad Subcommittee in this Congress, and especially the new members of our Subcommittee that I want to speak briefly about, and hopefully they will join us a little bit later.

On the Republican side, our new Vice Chair is Lynn Westmoreland of Georgia. Lynn, I understand, has quite a background in contracting and construction, and I am sure he is going to be a valuable resource to the Subcommittee as we move forward with our discussion of rail in America.

Next, Mike Sodrel of Indiana. I am told that Mike's family started in the transportation and logistics business back in 1867. So it looks like Mr. Sodrel has transportation in his blood, and I know that he is also going to be a great asset to the Subcommittee and we welcome him aboard.

Also joining us as a new member is Tom Osborne of Nebraska. The sports fans in the audience will probably recognize Tom. Before coming to Congress, he played professional football for the Washington Redskins and San Francisco 49ers, and of course he also served as head coach of the Nebraska Cornhuskers for 25 years, where he enjoyed winning seasons every year. We are happy to have Tom with us as well.

Today's hearing is on the subject of new technologies in railroad safety and security. According to data published by the Federal Railroad Administration, railroad safety has improved significantly over the past two decades. The latest statistics show that the overall accident rate has decreased 16 percent between 2000 and 2003. The rate of employee injuries has declined nearly 21 percent during that same period, and railroad employees have an injury rate lower than many other heavy industries. Working on the railroad is a difficult and often physically demanding job, and so I want to give credit to our railroad employees who strive to make safety a top priority.

Today we are going to hear testimony about new technologies in railroad safety, some of which are already yielding benefits to railroad employees, freight carriers, and the traveling public. In particular, we want to hear about some of the new technologies being developed by the FRA such as Positive Train Control and the signal systems being developed in Europe by Union Switch and Signal. I would be grateful to hear any comments regarding these technologies from the fellows in the front lines, the Brotherhood of Railroad Signalmen.

This hearing is not just about infrastructure, it is about rail transportation. I have heard several positive comments regarding a new generation of self-propelled railcars, and hope that we will hear details from Colorado Railcar.

A couple of housekeeping items before I yield to our distinguished Ranking Member. I want to ask unanimous consent to allow all members to have 30 days to revise and extend their remarks and to permit the submission of additional statements and materials by the witnesses. So ordered, without objection.

And then I am also advised that later during the hearing Ms. Norton of the District of Columbia may join us. Although a member of the full Committee, she is not a member of the Subcommittee, and would ask unanimous consent that she be permitted to participate in today's hearing. Without objection, so ordered.

And lastly, our distinguished Ranking Member, our regular distinguished Ranking Member, Ms. Brown of Florida is unavoidably detained in other parts of the world and will not be with us today. But we are lucky and honored to have with us Mr. Menendez from New Jersey to fill in ably for her.

At this time it is my pleasure to yield to you for any comments you may wish to make.

Mr. MENENDEZ. Thank you, Mr. Chairman. I am happy to sit in for our distinguished Ranking Member who, as you said, is unavoidably detained. I am happy to be a member of the Rail Subcommittee in this session of Congress.

However, I am not terribly happy about the status of rail safety and security in this country. I know our witnesses are here today to talk about new technologies that will make our trains safer and more secure, and I look forward to hearing what they have to say. But I would also like to see this Subcommittee hold a hearing on rail safety oversight, particularly in light of a number of recent accidents and the series of Pulitzer Prize winning articles in the New York Times last year regarding the cozy relationship between the Federal Railroad Administration and Union Pacific.

An Inspector General report from December brought to light a number of disturbing questions about FRA's regulatory oversight process and whether that process is sufficient to ensure public safety. I think this Subcommittee is exactly the right place to address that, but I think we are long overdue since we have not had a true rail safety oversight hearing in almost three years. However, that is for another day.

Today, we are here to discuss how technology can better protect the people that work, ride, or live alongside our Nation's railways. This is an extremely important issue for me since my district is tightly packed with freight and passenger rail lines, including the

Northeast corridor. If you add in subways, light rail, and commuter railroads, there are millions of people on the rails everyday in this country and we have not been spending nearly enough to ensure their safety.

That is why I introduced the Rail and Public Transportation Security Act earlier this year, which provides over $10 billion to address critical operating and capital needs for Amtrak, freight rail, and public transportation security, including $300 million for research, development, and field testing of new technologies.

In addition, my bill includes a welded rail and tank car safety improvement program that was developed in response to the derailment in Minot. The recent tragedy in South Carolina also shows us how seriously we need to take tank car safety and how we have to make a serious Federal commitment in order to protect people from both accidental and malicious disasters.

I am amazed that the Federal Government has not made this investment already. Rail systems are extremely vulnerable to terrorists attack, as shown by last year's attacks in Madrid. In fact, since September 11, there have been over five times as many attacks on public transportation targets than on airplanes.

I would ask my colleagues to imagine what we would have done, what action we would have taken if the Madrid train bombings had occurred in our homeland on our soil. What immediate investments would we be ready to make? What urgent action would we be willing to take? The new technologies we will hear about today are a first step towards that action, but we need to do more and we need to do it sooner rather than later.

I thank the witnesses for being here today. Thank you, Mr. Chairman, for holding this hearing.

Mr. LATOURETTE. I thank the gentleman very much.

We have been joined by some additional members at this time. I see the distinguished Chairman of the Aviation Subcommittee, Mr. Mica of Florida, has joined us and he has also brought guests, which we thank you very much for swelling the audience. It would be my pleasure to yield to you, Mr. Mica, for any observations you would like to make.

Mr. MICA. Thank you, Mr. Chairman. I appreciate your recognizing my guests. I have students from the Geneva Academy in Central Florida in the 7th congressional district, and several other voting age constituents, and I am always pleased to see them here and welcome them. But I want to also thank you, Mr. Chairman, for holding this hearing today, and also for your focus on new technologies and railroad safety and security issues. I think you have a great list of panelists.

The rail industry is facing some very serious challenges. I spoke with a group yesterday and liability is certainly one of the challenges that they face, along with others. But also providing new systems for safety which will provide less exposure for accidents and for the challenges that they face in providing a cost-effective alternative to paving over our country and providing a good means of moving commodity, freight, and other goods through our communities.

There are also challenges we know now by attempts to move hazardous and other materials through some of our communities. We

need to find ways to assist them to move those much-needed items through our communities, including even basic things like chlorine which we rely on for safe water supplies to our local municipalities and other water systems that need those chemicals.

So we face a number of challenges. I think this hearing will enlighten us as to what the Federal Railroad Administration and others have done to come up with new safety techniques. We will also hear recommendations I think that are necessary from the industry.

Finally, I am excited, I think you have got some folks from Colorado Railcar. I have taken a great interest in getting the United States into producing technologies that will take some of the cars off of our roads or at least give us some alternatives, and actually manufacture once again in the United States some of the essential equipment for the future.

So, again, I thank you. I look forward to hearing from the panelists. And I again welcome our guests.

Mr. LATOURETTE. I thank the gentleman. Ms. Johnson of Texas, any remarks?

Ms. JOHNSON. Thank you very much, Mr. Chairman, Ranking Member, for holding this hearing. It is my first one on this Subcommittee and it is an important one to me because, as we know, our Nation's transportation system is the backbone of our economy and our way of life. Every day various modes within the Nation's transportation system transports millions of people and tons of goods throughout the country. So critically important to this equation is the role of secure freight and passenger rail systems.

While the tragic events of September 11, 2001 have forced us to take a hard look at how we secure our various modes of transportation, rail security remains a significant challenge. According to GAO, a number of positive steps have been taken by rail stakeholders to bolster the Nation's rail security since that time, such as performing risk assessments, emergency drills, and developing security plans. However, one only needs to turn to the news or pick up a local newspaper to realize that our Nation's rail systems still remain extremely vulnerable to the possibility of terrorist attacks that could jeopardize countless lives and cause serious economic disruption. For example, on June 28th of last year two freight trains carrying chlorine gas collided in my State killing three people. Only one of the dead was aboard; the others died as a result of gas drifting over a residential neighborhood over a mile away. Further, we must never forget the horrific Madrid train bombings last year that left 200 commuters dead and 1,500 wounded.

These incidents and countless others highlight the unique challenges and risks associated with the rail system. So while I am heartened by GAO's findings, more work remains to be done, particularly in resources invested toward surface transportation concerns. I feel strongly that as policymakers we must revive our resolve to approach rail security challenges with a sense of urgency. To do otherwise only serves to further compromise the safety of the American public. According to the Mineta Institute, globally, surface transportation systems were the target of more than 195 terrorist attacks from the 1997 through the year 2000.

As I close, I want to thank our witnesses that have come before us to testify this morning. I look forward to your testimony. I am particularly interested in learning more about the latest security innovations, the level of coordination among rail stakeholders, and what we as a body may do to further assist them to help bolster freight and passenger security efforts. So thank you again, Mr. Chairman, for this hearing.

Mr. LATOURETTE. I thank the gentlelady very much. In a moment I will yield to Mr. Miller, Westmoreland, and Osborne for comments they would like to make. But I see we have been lucky enough to be joined by the distinguished Ranking Member of the full Committee. And so this must be an important hearing if Mr. Oberstar is here.

Mr. Oberstar, I would yield to you for any observations you would like to make.

Mr. OBERSTAR. Mr. Chairman, all of your hearings are important ones. But when it comes to safety, whether in rail, or aviation, or highways, maritime, it gets my attention. And it is a very promising initiative on your part to explore in the context of a hearing new technologies that may improve both safety and security. But I think to deal with the issue fully, we need to go beyond technology.

We have seen in recent years there is an increase in rail accidents, not an alarming increase, but an increase that gets my attention and that of the National Transportation Safety Board and the Federal Railroad Administration. There were over 3,100 accidents in 2004. That was up from just under 3,000 in 2003, 2,700 accidents in 2002. The trend is in the wrong direction. And then we had the catastrophic accident in Graniteville, South Carolina, that the NTSB said was a result of improperly lined switches. The IG at the Department of Transportation said that the trend of rail safety data indicates improperly lined switches are the second leading cause of rail accidents and the principal cause of accidents resulting from human error.

Technology helps, technology is vitally important, but in the end, people make these decisions. Properly trained people, properly experienced people can avoid accidents with the right technology. The IG Report in February of this year on Safety Findings and Recommendations at the FRA show that serious safety problems have been present for all four of our major railroads, and that despite an increase in the civil penalties that FRA has assessed on those railroads.

But the IG also highlights prior audit report recommendations that the Federal Railroad Administration has failed to implement. The IG's 2002 report recommended that FRA make greater use of inspection results developed in the Safety Assurance and Compliance program. Now the RSAC was initiated many years ago, almost a decade ago. It initially had good results. But if the recommendations from RSAC are not implemented, then they do not do any good, there is not a life-saving benefit.

Now I am very encouraged that at the outset of your tenure as Chairman of the Subcommittee you are putting this spotlight on safety. I hope that it will not be a momentary event, that this will be followed up with further inquiries suggested by the information

we will receive in the course of today's hearing. I have read the testimony in advance. If my time permits, I will have some questions about various elements.

Just recently, for example, the problems with Acela, the rotor brakes that have demonstrated slim, spider-like cracks that have migrated into major failures raise questions about the underlying technology—was the metal cast properly, at the proper temperature, was it cooled properly in the sequential cooling that is necessary to ensure that bubbles do not develop in the interior of the casting.

I am reminded of the disaster of United Airlines DC-10 over Iowa, when the rotor in the tail engine, the titanium block into which the fan blades are inserted, catastrophically failed. One hundred and ten people lost their lives. It was a miracle that pilot was able to bring that aircraft down; it had lost all hydraulics. That was because of a number of failures that started with the casting of that titanium block.

Now, we have 131 rotors in the Acela that have failed, for a combination of reasons perhaps going back to the original design specifications, but also the subsequent inspection and perhaps over-ambitious five-year life schedule for those rotor brakes, and perhaps also, as some are suggesting, our design specification of a railcar that is twice as heavy as European railcars where this technology originated.

If our Federal Railroad Administration is not being vigilant on these matters and is not looking at these matters in depth and is not following up on them, then this Committee has a responsibility to do it. And you have made a good start today, Mr. Chairman, and I thank you very much.

Mr. LATOURETTE. I thank the gentleman very much. I would tell the distinguished Ranking Member it is our intention to have a rather vigorous schedule of hearings, working with you and Ms. Brown and Chairman Young, and the Acela rotor issue will be the subject of a hearing occurring on May the 11th and we will explore that issue in detail.

Mr. Miller, anything you care to say?

Mr. MILLER. Thank you, Mr. Chairman. Rail safety is extremely important in my district because of the increase in California we are going to experience in freight movement. My district seems to be the largest gateway for trade in the country. We have both the Long Beach and the L.A. harbors that all those ships are coming into each year, and about $250 billion worth of cargo either comes through my district or most of my district via train or truck. It is very problematic.

We are looking by 2020 at about two and a half to three times the amount of trains we experience today will be basically impacting our districts. We have a tremendous problem with at-grade crossings. Most of my communities, which really surprised me, over the last eight or ten years have pretty much been up in arms and trying to be proactive about the issue of the amount of impact that they face trying to cross those at-grade crossings, whether it is trucks trying to deliver goods, or people trying to get back and forth to work or take their kids to school.

Rail safety is becoming a huge issue. We just recently, on January 26th, in Glendale had a Metrolink train that slammed into an SUV killing 11 people. It also clipped a northbound Metrolink train, which could have been very disastrous. In April of 2002, we had 3 people killed and 260 people were injured in Placentia, in my district, when a freight train missed a light and ran into a commuter train. And in June 2003 we had a runaway train in Commerce that went through my district and it destroyed six houses. It was a miracle that nobody really was injured in that accident. But what that has done is brought an acute awareness of the situation we face in California. Rail safety is absolutely something that has to be addressed.

In California, about $802 billion worth of goods are shipped from our State each year. That is either going on a truck or most of it is going on a train, especially through the central part of the United States. So we have a challenge with increased freight movement and we need to be ready to deal with the issue as it increases, and safety is something that is paramount. I trust that our economy is going to continue to grow, that nothing will happen to that. And if it does, and I believe it will, we are also going to be increasing the amount of freight and goods that are going to be moved.

So I am looking forward to the testimony today, and I am glad you are here. Welcome.

Mr. LATOURETTE. I thank you, Mr. Miller.

Coach Osborne and Mr. Sodrel, you missed the glowing introductions I gave of you at the beginning of this hearing. We would like to get to the witnesses, but if there are brief comments you would like to make. Mr. Osborne, first to you? Mr. Sodrel?

Mr. SODREL. I would just like to thank the witnesses for coming here today. I spent my professional life in highway transportation, so I will be getting an education on rail, although I have a brother-in-law, retired UTU conductor and several friends who were engineers that started out on the old Louisville-Nashville railroad years ago. So I thank the witnesses for being here, and I thank you, Mr. Chairman.

Mr. LATOURETTE. I thank the gentleman.

Today's hearing is comprised of three panels. The first panel has Ms. Jo Strang, the Deputy Associate Administrator for Railroad Development at the Federal Railroad Administration, and also Bob Chipkevich, who is the Director of Railroads, Pipelines, and Hazardous Materials Investigations Department at the National Transportation Safety Board. We thank both of you for coming. We have received your written observations and we look forward to your testimony.

Ms. Strang, welcome. We will start with you.

TESTIMONY OF JO STRANG, DEPUTY ASSOCIATE ADMINISTRATOR FOR RAILROAD DEVELOPMENT, FEDERAL RAILROAD ADMINISTRATION; BOB CHIPKEVICH, DIRECTOR OF RAILROADS, PIPELINES, AND HAZARDOUS MATERIALS INVESTIGATION DEPARTMENT, NATIONAL TRANSPORTATION SAFETY BOARD

Ms. STRANG. Thank you. Mr. Chairman and members of the Subcommittee, I very much appreciate the opportunity to appear before you today, on behalf of Secretary Mineta and Acting Administrator Robert Jamison, on the subject of new technologies in railroad safety. I would appreciate your submitting my full statement for the record; I plan to summarize it.

I supervise the Federal Railroad Administration's research, development, and demonstration efforts, so I pay a great deal of attention to new technologies in safety. Prior to this, I supervised the National Transportation Safety Board's rail and rail transit accident investigations, so I am familiar with the consequences of railroad safety problems.

Safety is our top priority, and the promise that technology holds to improve safety is compelling. Recent statistics show that the industry as a whole is getting safer, but the spate of recent accidents shows that we still have room to improve, and we must accelerate the rate of progress.

In general, the safety trends on the Nation's railroads are favorable. The data for calendar year 2004 show that since 2003 total rail accidents and incidents are down slightly, and employee casualties are down about 8 percent.

However, not all trends are positive. Improvements in the rate of train accidents have slowed, and bad accidents continue to occur. FRA is committed to improving this record, and we are focusing on ways to prevent, eliminate, or minimize the harm resulting from train accidents. I will focus my testimony on new technologies that hold great promise to improve rail safety.

Track defects accounted for 34 percent of derailments over the last five years. FRA has an active research program for developing and deploying enhanced track inspection systems as a preventative approach to reducing track accidents. I will describe some of the key systems that FRA is currently developing.

This is a picture of a crack in a joint bar. First, is an automated joint bar inspection system. Current joint bar inspection practices rely mostly on visual inspection and, in a few cases, hand mapping with ultrasonic probes. These methods are time-intensive and prone to human error. FRA is developing an automated photo inspection system that will identify cracks in joint bars.

This is a picture of the completed joint bar inspection system. Our initial tests showed that a prototype system mounted to a rail vehicle and operated at 30 miles per hour was able to detect all cracked bars identified by visual inspection, as well as additional cracks undetected by the human eye.

Internal rail defects due to fatigue remain a serious problem which has been exacerbated by recent trends in increasing freight axle loads. Internal defects can be identified only by specialized ultrasonic or induction measurement cars that still cannot be oper-

ated at more than 10 miles per hour. Defects in the web or the base of the rail are also extremely difficult to detect.

So far I have only talked about the parts of the rail you can see. But we also need a way to inspect the subgrade, or the part beneath the track. FRA has identified ground-penetrating radar as a promising technology for finding poor track conditions that are hidden below the surface, and is working on developing a prototype system which will produce quantitative indices of track subsurface conditions. Once the prototype is completed, it will be installed on FRA's T-18 car for field testing in the spring of 2006.

Collisions and overspeed derailments must also be prevented. PTC is an advanced train control technology that can prevent train collisions with automatic brake applications. It also provides for automatic compliance with speed restrictions and enhanced protection of roadway workers.

FRA's final rule enabling Positive Train Control became effective in March 2005. The rule is a performance standard for a system railroads may choose to install, but does not require it to be installed. FRA is promoting the implementation of PTC by sponsoring development of technologies through partnerships with States and railroads, and by helping to provide NDGPS, a satellite-based navigation aid.

FRA is also working on projects in Illinois, Michigan, Wisconsin, and Alaska. A significant challenge for FRA and the railroads in developing all such systems is to lower the cost of implementation.

A fundamental technology for enabling the implementation of PTC systems is a network of reference stations that monitors GPS and transmits correction signals to an unlimited number of users, known as the Nationwide Differential Global Positioning System, or NDGPS. Any NDGPS receiver can then use these signals to improve the accuracy and integrity of GPS. When complete, there will be dual coverage throughout the United States to ensure the signals are always available.

GPS has an accuracy of about 36 meters. Since parallel railroad tracks are only 4 meters apart, GPS accuracy does not meet our needs. Basic NDGPS improves the accuracy to 1 to 2 meters. Similarly, the GPS system takes two to four hours to recognize that a satellite is out of tolerance and to notify the users. This is referred to as "time-to-alarm integrity." Basic NDGPS improves the time-to-alarm integrity to six seconds. So, if a GPS satellite malfunctions, the NDGPS system eliminates the bad satellite from the position solution within six seconds, preventing any disruption to railroad operations.

While we are trying to find ways to protect against derailments and collisions, we also need to protect train occupants now. In contrast to European and Asian rail systems, traffic on the U.S. rail system is dominated by private freight traffic. FRA continues to address the crashworthiness of passenger equipment and passenger and crew protection through our crash test program.

Computer models have been developed to simulate a variety of passenger rail car crash scenarios. These models, combined with the results of crash tests and field investigations of passenger train accidents, are being used to develop strategies for increasing occupant protection.

FRA is now testing components of structural crash worthiness for passenger rail equipment. We have completed both designs and test of the crush zone design for coaches. The results from the impact tests show that crash energy management design has superior performance over conventional equipment design.

I would like to show a few videos now. The first one is a single car impact test. The first clip you will see is conventional equipment with no modification.

[Video presentation.]

Ms. STRANG. You can see the result of the impact. Clearly, there would be loss of survival of space. The car was crushed severely.

In the next clip, you will see a crash energy modified system which FRA has developed. By using design components to modify the energy, survival space remains much better preserved.

[Video presentation.]

Ms. STRANG. The next video will show two cars coupled together and using crash energy management. In a conventional train-to-train coupling, the lateral forces force the train out of alignment and you get the typical accordion type of derailment that you have seen. This keeps the train cars in line with each other so that they are less likely to derail.

[Video presentation.]

Ms. STRANG. You could see at the end, this is an overhead, how the cars remained together instead of being out of alignment.

The next video is a train-to-train collision. We have planned another test in February, we hope, of this year that will have all crash energy modified cars, and we will be able to see what will happen.

[Video presentation.]

Ms. STRANG. I would like to invite anybody on this Committee if you would like to see the next crash test.

I would also like to point out that Metrolink, a commuter railroad in California, is working with us to deploy crash energy management systems in their next purchase.

FRA is also actively addressing the crash worthiness of freight locomotives. Participants include the passenger and freight railroads, rail labor organizations, and locomotive builders.

I have additional videos if time permits. Thank you, and I will be happy to answer your questions.

Mr. LATOURETTE. I thank you very much. I think, before we go to Mr. Chipkevich, one of us did have a question. That second train-to-train, was it 30 miles an hour?

Ms. STRANG. It was 26.4.

Mr. LATOURETTE. It was 26.4. Thank you very much.

It is now my pleasure, Mr. Chipkevich, to ask you for your observations. Just again, without objection, all of the witnesses full statements will be made part of the record of this hearing and I would ask you to summarize your remarks as best you can. Thank you.

Mr. CHIPKEVICH. Thank you. Thank you, Chairman LaTourette and members of the Subcommittee. I want to thank you for the opportunity to testify today on behalf of the National Transportation Safety Board on an important rail safety issue, Positive Train Control.

The NTSB has been investigating train collision and over-speed accidents for over 35 years and issued our first recommendation related to this issue after a 1969 head-on collision between two Penn Central commuter passenger trains in Darien, Connecticut. The Safety Board in 1970 recommended that the Federal Railroad Administration study the feasibility of requiring a form of automatic train control at points where passenger trains are required to meet other trains.

Since 1970, the Safety Board has issued numerous safety recommendations related to positive train separation. Our most recent safety recommendation was issued in 2001, following a collision between three Conrail freight trains in Bryan, Ohio. The trains were operating in fog, when a faster moving train missed a signal and hit the rear-end of a train that had slowed because of the poor visibility. A third train, coming in the opposite direction, struck the two derailed trains. The Safety Board has recommended that the FRA facilitate actions necessary for the development and implementation of Positive Train Control systems that include collision avoidance, and require implementation of Positive Train Control systems on main line tracks, establishing priority requirements for high-risk corridors such as those where commuter and intercity passenger trains operate.

This safety recommendation was reiterated to the FRA after a Burlington Northern Santa Fe freight train collided head-on with a Metrolink passenger train in Placentia, California in 2002.

In the past six years, NTSB has investigated 38 accidents where Positive Train Control is a safety issue. Causal factors have been attributed to train crew mistakes and failure to operate trains in accordance with operating rules. Human factor causes have included fatigue, sleep-apnea, use of medication, reduced visibility, and distractions such as cell phone use. Further, FRA accident data show that for 2003 and 2004 human factor causes to head-on, rear-end, and side collision accidents were about 91 percent.

NTSB is currently investigating five accidents involving freight train collisions. As a result of a collision between two trains in Macdona, Texas, on June 28, 2004, a tank car filled with chlorine was breached, resulting in three fatalities and a significant public evacuation. NTSB will examine whether Positive Train Control could have prevented the Macdona accident and another accident that occurred in Graniteville, South Carolina, on January 6, 2005. After the Graniteville accident, a switch on the main track was found in the open position to a siding. As a result of this accident, a tank car filled with chlorine was breached, resulting in nine fatalities.

Progress on Positive Train Control has been slow. This safety issue has been on the NTSB's list of Most Wanted Transportation Safety Improvements since 1990. Notwithstanding the slow progress on Positive Train Control, the FRA has issued standards to address modern electronic systems and emerging technology in the signal and train control arena. The final rule should provide safety-critical standards that equipment must meet for use in Positive Train Control systems, but it will not provide interoperability standards that need to be addressed when equipment operated by different railroads is used on the same track. The FRA, the Asso-

ciation of American Railroads, and the Illinois Department of Transportation are funding the North American Joint Positive Train Control Project to help address equipment and operational issues that occur when different railroads use the same track.

Positive Train Control systems can prevent human factor caused accidents, and the NTSB will continue to urge implementation of PTC systems through our accident investigations and the attention of our list of Most Wanted Transportation Safety Improvements.

Thank you for the opportunity to testify.

Mr. LATOURETTE. I thank you very much for not only your testimony, but summing it up before the red light came on. That was very nice of you. I appreciate that.

Ms. Strang, I think you answered this question in your testimony, but I just want to be clear. When you were talking about Positive Train Control systems, the rulemaking that the FRA is currently undergoing, it is my understanding that you said the rulemaking would make those systems optional and the intention is not to make them mandatory at this time.

Ms. STRANG. That is correct. The rule was published on March 7, 2005, as a final rule. It is an operational standard, if you will. It just sets the conditions and requirements for Positive Train Control systems, but it does not mandate it.

Mr. LATOURETTE. Ms. Strang also, the passenger survivability in a crash is influenced by a number of factors—standees in a coach, for instance, can become projectile, harming or killing other passengers; the location of the crash also matters as to whether it is in an urban center where medical attention is more readily available or a rural setting. Is the FRA considering all of those factors as you look at passenger survivability?

Ms. STRANG. Yes. Actually, in 1999 we issued comprehensive standards on passenger crashworthiness that included emergency preparedness and egress types of standards, so that we would have available windows and doors that function well in an emergency and people can exit. We continue to work on passenger crashworthiness and survivability through the American Public Transportation Association, their passenger requirements group, that sets the industry standards for public transit. These can then be incorporated into the next revision of the passenger crashworthiness rule.

Mr. LATOURETTE. It is my understanding, though, that your rulemaking may not include an examination of interior materials such as padding, is that right?

Ms. STRANG. No. We have done fire testing, and we have also done injury testing at tables.

Mr. LATOURETTE. Right. That was one of my questions I think, the whole issue of whether

Ms. STRANG. Actually, table design is important. We have done tests where we took different types of tables and looked at how their edges were and how they were fixed. They are popular with commuters.

Mr. LATOURETTE. Mr. Menendez, in his opening remarks, correctly called upon the issue of tank car safety. Can you tell us a little bit about what the FRA is doing relative to tank cars?

Ms. STRANG. Sure, I would be delighted to. FRA is currently undertaking tank car research that resulted from the Minot, North Dakota, accident in 2002. We are working with the Volpe National Transportation Systems Center and the AAR Tank Car Committee to do several things.

One, we have to understand how tank cars fail when they are in a derailment. So we are doing a three-phase model that includes a physics model, a kinematics model, using finite element analysis, and then we will validate the model. Once we have a better understanding of how tank cars fail in derailments and collisions, we will be able to address the structural concerns through design.

Mr. LATOURETTE. Later in the hearing when Mr. Pickett testifies, he expresses concern that the visual inspection of the track is sometimes conducted at too high of speeds. During your testimony, I think I wrote down that it was your feeling that 30 miles an hour was a safe speed. I believe in his testimony, I think he is proposing a limit of 15 miles an hour. Could you share your view on that?

Ms. STRANG. Certainly. The 30 miles per hour was with a high-speed automatic photographic system, not a human eye. I do not believe the human eye is designed to detect small cracks at 30 miles an hour.

Mr. LATOURETTE. And so what about his observation that he will make later that 15 miles an hour is more appropriate?

Ms. STRANG. It seems reasonable to me. But I am not on the regulatory side of things.

Mr. LATOURETTE. Okay. Thank you very much. Mr. Menendez?

Mr. MENENDEZ. Thank you, Mr. Chairman.

Ms. Strang, in your testimony you say that the data for 2004 shows that the total accidents and incidents are down 3.9 percent from 2003. However, the data that I have seen from the FRA website, which is the same data that Mr. Oberstar referred to in his statement, show that the total number of accidents is increasing. It showed that highway-rail incidents also increased from 2003 to 2004, and that the only other statistic that improved is something labeled “other incidents.”

Ms. STRANG. It depends on which—there are a lot of different categories.

Mr. MENENDEZ. I have not gotten to my question yet.

Ms. STRANG. Oh, I am sorry.

Mr. MENENDEZ. So my question is, if we extracted out the accident category alone, what would the number be?

Ms. STRANG. I do not have that number with me, but I can provide it to you. I do know that collisions have increased. But the total train accident/incident rate has decreased. But I will provide those to you.

[The information received follows:]

Federal Railroad Administration (FRA)
Inserts to the Record of Testimony by Jo Strang,
Deputy Associate Administrator for Railroad Development, FRA,
at the April 28, 2005, Hearing
before the Subcommittee on Railroads,
Committee on Transportation and Infrastructure,
House of Representatives

ANSWER: As you may know, the data reported to FRA by the railroads for accidents/incidents in calendar years 2003 and 2004 are still preliminary. It is FRA=s standard practice to review the reported information for possible errors and inconsistencies and to refine it before treating the figures as final.

Updated figures provided to me in June 2005, after this hearing, indicate that there were a total of 3,157 train accidents in 2004 and that the train accident rate for 2004 was 4.10, which is slightly higher than the 4.03 train accident rate for 2003. Also, updated figures show that there were 13,939 railroad accidents/incidents (all events arising from the operation of a railroad that must be reported under FRA=s accident reporting regulations) during 2004, down 2.1 percent from the 14,239 railroad accidents/incidents in 2003.

As further background for this discussion, I would like to include for the record a table of railroad accident/incident statistics updated by FRA in June 2005. Please note that the differences between the statistics cited in my testimony and those in the chart that we are now providing are accounted for by further refinement and amendments to the data during the time between the preparation of my testimony and the preparation of this answer for the hearing record. This answer for the hearing record is more current and more accurate. Please see the attached chart, designated FRA Exhibit 1.

Accident/Incident Details-2004

(2003 Details) ***Preliminary 2000 through 2004*** (2005 Details)

- Accident/Incident Counts and Rates
- Summary of Operational Data
- Summary by Type Incident and Type Person
- Accident/Incident Rates - Class I Railroads
- Train Accidents by Railroad (excluding highway-rail crossing)
- Train Accidents by State (excluding highway-rail crossing)
- Total Casualties by State
- Total Employee on Duty Cases by Railroad
- Total Highway-rail Crossing Incidents by Railroad
- Total Highway-rail Crossing Incidents by State
- Highway-rail Crossing Incidents Casualties by Railroad
- Total Highway-rail Crossing Incidents Casualties by State
- Trespasser Casualties by Railroad (not at highway-rail crossing)
- Trespasser Casualties by State

TOTAL ACCIDENTS/INCIDENTS, JAN - DEC (2004 preliminary)

	Counts				Percent Change	
	2001	2002	2003	2004	2003-2004	2001-2004
01 RAILROADS REPORTING	679	677	683	700	2.5	3.1
02 TOTAL ACCIDENTS/INCIDENTS	16,087	14,404	14,239	13,939	-2.1	-13.4
03 Fatalities	971	951	865	899	3.9	-7.4
04 Nonfatal	10,985	11,103	9,151	8,715	-4.8	-20.7
05 TRAIN ACCIDENTS	3,023	2,738	2,996	3,157	5.4	4.4
06 Fatalities	6	15	4	13	225.0	116.7
07 Nonfatal	310	1,884	227	224	-1.3	-27.7
08 Collisions	220	192	198	257	29.8	16.8
09 Derailments	2,234	1,989	2,121	2,275	7.3	1.8
10 Other	569	557	677	625	-7.7	9.8
11 Track causes	1,121	941	973	980	0.7	-12.6
12 Human factors	1,035	1,050	1,212	1,278	5.4	23.5
13 Equipment causes	427	367	361	401	11.1	-6.1
14 Signal causes	42	50	58	60	3.4	42.9
15 Misc. causes	398	330	392	438	11.7	10.1
16 Yard accidents	1,569	1,478	1,647	1,748	6.1	11.4
17 HIGHWAY-RAIL INCS.	3,237	3,077	2,963	3,045	2.8	-5.9
18 Fatalities	421	357	332	368	10.8	-12.6
19 Nonfatal	1,157	999	1,028	1,070	4.1	-7.5

20 OTHER INCIDENTS	9,827	8,589	8,280	7,737	-6.6	-21.3
21 Fatalities	544	579	529	518	-2.1	-4.8
22 Nonfatal	9,518	8,220	7,896	7,421	-6.0	-22.0
23 EMPLOYEE FATALITIES	22	20	19	24	26.3	9.1
24 EMPLOYEE NONFATAL	7,815	6,644	6,204	5,799	-6.5	-25.8
25 TRESPASSER FATALITIES	511	540	501	484	-3.4	-5.3
26 TRESPASSER NONFATAL	404	395	396	397	0.3	-1.7

Date of run: Wed, Jun 1, 2005

SUMMARY OF ACCIDENT/INCIDENT RATES
JAN - DEC (2004 preliminary)

Type	2001	2002	2003	2004	Chg 2003 2004	Chg 2001 2004
Tot accidents/incidents	13.56	12.18	11.92	11.36	-4.70	-16.2
Train accidents	4.25	3.76	4.03	4.10	1.86	-3.39
Yard accidents	18.30	18.25	20.16	20.82	3.30	13.80
Other track	2.32	1.95	2.04	2.06	0.88	-11.5
Highway-rail incs.	4.55	4.22	3.99	3.96	-0.66	-13.0
Employee on duty	3.30	2.94	2.76	2.54	-7.83	-22.9
Trespassers	1.29	1.28	1.21	1.15	-5.06	-10.9
Passengers on train	4.78	5.83	4.49	3.85	-14.2	-19.4

Date of run: Wed, Jun 1, 2005

Notes:

Tot accidents/incidents rate is the total number of accidents/incidents reported times 1,000,000, divided by the sum of train miles and hours

Train accident rate is the number of train accidents times 1,000,000 divided by total train miles.

Yard accident rate is the number of train accidents that occured on yard track times 1,000,000 divided by the number of yard switching train miles

Other track rate is the number of accidents that did not occur on yard track

times 1,000,000 divided by total train miles minus yard switching train miles.

Highway-rail incident rate is the number of incidents times 1,000,000 divided by the total number of train miles.

Employee on duty rate is the number of reported cases (fatal and nonfatal times 200,000 divided by the number of employee hours worked.

Trespasser rate is the number of reported cases (fatal and nonfatal), excluding those associated with highway-rail incidents times 1,000,000 divided by the total train miles.

Mr. MENENDEZ. Would you extract the accident category alone and then let the Committee know?

Ms. STRANG. Absolutely.

Mr. MENENDEZ. Thank you. What is the “other incidents“ category?

Ms. STRANG. Other incidents are things like cows on the track, or an object that is there. It is not something that is normal.

[The information received follows:]

ANSWER: Excuse me. I misspoke. Basically, an incident in the Aother incidents@ category is an event arising from the operation of a railroad, except for a train accident or a highway-rail grade crossing accident, that results in death or reportable injury to one or more persons or occupational illness to one or more railroad employees. Predominantly, Aother incidents@ involve the death, injury, or occupational illness of railroad employees or the death or injury of trespassers to railroad property, but again, not if the death, injury, or occupational illness results from a train accident or a highway-rail grade crossing accident/incident.

As illustrated by FRA Exhibit 1, which is printed from FRA=s Web site, the site divides all railroad accident/incidents reported to FRA under 49 C.F.R. part 225 into the following three, mutually exclusive categories:

(1) train accidents and resulting deaths and injuries or occupational illnesses (ANonfatal@) (lines 05, 06, and 07, respectively, on FRA Exhibit 1);

(2) Ahighway-rail incs.@(meaning highway-rail grade crossing accidents/incidents) and resulting deaths and injuries or occupational illnesses (lines 17, 18, and 19, respectively); and

(3) other incidents and resulting fatalities and deaths and injuries or occupational illnesses (lines 20, 21, and 22, respectively).

So the Aother incidents@ category is a residual category. As for definitions of the other two categories of railroad accidents/incidents, a highway-rail grade crossing accident/incident is an impact between railroad on-track equipment and one or more highway users at a crossing. The term Atrain accident@ is generally synonymous with the term Arail equipment accident/incident@ as used in FRA=s accident reporting regulations; basically, a train accident is a derailment, collision, or other event involving the operation of on-track equipment (standing or moving) that results in damage to railroad equipment, track, track structures, roadbed, or signals valued at more than the current dollar reporting threshold. See 49 C.F.R. 225.19(c). For calendar years 2002 through 2005, the reporting threshold is $6,700. However, to avoid double-counting, crossing accidents/incidents that also qualify as rail equipment accident/incidents (because specified damages exceed the reporting threshold) are excluded from the figures on train accidents.

I would like to provide for the record an analysis, dated May 18, 2005, of Aother incidents@ during 2004, showing the circumstances of the incident and the physical activity involved, in descending order by frequency. As the chart shows, some of the typical circumstances involved in these 7,756 Aother incidents@ were as follows:

! slipping, falling, or stumbling for various reasons while walking or in other activity (generally involving employees);

! being struck by on-track equipment while walking (261 incidents, involving, e.g., 247 trespassers) or while lying down (102 incidents, involving 101 trespassers and one nontrespasser); and

! collision/impact while riding an automobile, truck, bus, or van (103 incidents, 86 employees involved).

Please see the attached FRA Exhibit 2.

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

1
06:45 Wednesday, May 18, 2005

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Slipped, fell, stumbled, other, Walking	285	136	9	44	69	6	15	5	1		
Struck by on-track equipment, Walking	261	11	247		2				1		
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Walking	231	214	1	2	5	1	8				
Slipped, fell, stumbled, etc. due to climatic condition, Walking	197	127	1	13	32	5	18	1			
Slipped,fell,stumbled,etc. due to irregular surface, Walking	160	120	1	5	15	7	11			1	
Collision/impact - auto, truck, bus, van, etc., Riding	103	86	3		3		11				
Struck by on-track equipment, Lying down	102		101		1						
Struck by on-track equipment, Laying	99		99								
Collision/impact - auto, truck, bus, van, etc., Driving (motor vehicle, forklift, etc.)	98	58	7		5	13	12	2	1		
Overexertion, Lifting equipment (tools, parts, etc.)	89	88					1				
Slipped, fell, stumbled, other, Getting off	88	43	2	40	2		1				
Lost balance, Walking	84	33	3	32	14		2				
Overexertion, Lifting other material	80	78						2			
Overexertion, Lining switches	78	76			1			1			
Struck by on-track equipment, Standing	77	6	68		1			1	1		
Slipped, fell, stumbled, other, Stepping down	72	36		20	11		5				
Overexertion, Pulling	61	57		1	1	1		1			
Struck by on-track equipment, Sitting	61	4	54	3							
Slipped,fell,stumbled,etc. on oil, grease,etc., Walking	53	39		3	5	4	1	1			
Struck against object, Walking	51	25	2	9	7	2	6				
Overexertion, Handbrakes, applying	51	51									
Slipped, fell, stumbled, other, Descending	50	31		3	10	5	1				
Struck by object, Standing	45	27		4	6	5	1	1	1		
Slipped, fell, stumbled, other, Getting on	45	15	2	25	3						
Overexertion, Opening	41	37		2		1		1			
Caught, crushed, pinched, other, Closing	39	37					1	1			
Collision/impact - auto, truck, bus, van, etc., Sitting	36	25					11				
Slipped, fell, stumbled, other, Riding	35	13	11	1	10						
Stepped on object, Walking	34	30			2		2				
Collision - between on track equipment, Sitting	34	16		18							
Overexertion, Handbrakes, releasing	31	31									
Sudden/unexpected movement of on-track equipment, Standing	30	19		10				1			
Struck by object, Using hand tool	30	25					1	4			
Slipped, fell, stumbled, etc. due to climatic condition, Stepping down	29	18		3	4		4				
Lost balance, Riding	29	8	4		16		1				
Slipped, fell, stumbled, other, Climbing over/on	28	13	7	2	1	2	1	2			
Lost balance, Standing	27	11	1	10	2	3					
Struck by on-track equipment, Running	27		26		1						

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Getting off	27	26						1			
Struck against object, Riding	26	19	3	1	3						
Overexertion, Using hand tool	25	24				1					
Sudden/unexpected movement of vehicle, Driving (motor vehicle, forklift, etc.)	25	14	3		3	3	2				
Sudden/unexpected movement of vehicle, Riding	25	21	1			1	1	1			
Slipped, fell, stumbled, etc. due to climatic condition, Getting off	25	21		1	1		2				
Struck by object, Walking	24	16	1	4	1			1	1		
Lost balance, Stepping down	24	18		2	1		2	1			
Slipped,fell,stumbled,etc. due to irregular surface, Getting off	24	18		3	3						
Struck by object, Opening	23	20			2			1			
Slack action, draft, compressive buff/coupling, Riding	23	23									
Caught, crushed, pinched, other, Opening	23	20		2	1						
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Stepping down	22	22									
Overexertion, Climbing over/on	22	22									
Slipped, fell, stumbled, other, Standing	22	9		9	3	1					
Lost balance, Getting off	22	8	3	9	2						
Struck by falling object, Standing	21	15		1	2	1	1	1			
Struck against object, Sitting	21	14		6	1						
Slipped, fell, stumbled, other, Running	21	2	2	2	12		2		1		
Lost balance, Descending	20	11		2	6				1		
Other (describe in narrative), Walking	20	15	3	2							
Overexertion, Bending, stooping	20	19						1			
Assaulted by other, Standing	20	19			1						
Struck by on-track equipment, Driving (motor vehicle, forklift, etc.)	20	2	14		2	1		1			
Exposure to fumes - inhalation, Riding	20	20									
Overexertion, Loading/unloading	19	19									
Overexertion, Pushing	19	19									
Slipped, fell, stumbled, etc. due to climatic condition, Getting on	19	5		10	4						
Struck against object, Standing	18	9		5	2	1	1				
Slipped,fell,stumbled,etc. due to irregular surface, Stepping down	18	13		4		1					
Sudden, unexpected movement, other, Sitting	17	13		3			1				
Exposure to fumes - inhalation, Standing	17	15						2			
Other (describe in narrative), Other (Narrative must be provided)	17	10	5	1		1					
Sudden/Unexpected Movement of tools, Using hand tool	17	17									
Caught, crushed, pinched, other, Handling, other	17	16						1			
Overexertion, Carrying	16	14				2					

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

06:45 Wednesday, May 18, 2005

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Struck by object, Loading/unloading	16	12	.	.	2	.	1	1	.	.	.
Caught, crushed, pinched, other, Walking	16	12	.	3	.	1	.	.	.	.	.
Slipped, fall, stumbled, other, Stepping up	16	6	.	9	.	.	1	.	.	.	.
Struck by thrown or propelled object, Using hand tool	16	16	.	.	.	.	.	.	.	.	.
Exposure to fumes - inhalation, Operating	16	16	.	.	.	.	.	.	.	.	.
Slipped, fall, stumbled, etc. due to climatic condition, Descending	15	6	.	.	6	1	.	2	.	.	.
Caught, crushed, pinched, other, Riding	15	10	5	.	.	.	.	.	.	.	.
Sudden/unexpected movement of on-track equipment, Riding	15	11	1	.	3	.	.	.	.	.	.
Caught, crushed, pinched, other, Repairing	15	15	.	.	.	.	.	.	.	.	.
Struck by falling object, Repairing	15	15	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Adjusting other	15	15	.	.	.	.	.	.	.	.	.
Overexertion, Digging, excavating	14	14	.	.	.	.	.	.	.	.	.
Lost balance, Climbing over/on	14	10	2	.	.	1	.	1	.	.	.
Slipped, fall, stumbled, other, Sitting	14	9	.	4	1	.	.	.	.	.	.
Overexertion, Adjusting drawbar	14	14	.	.	.	.	.	.	.	.	.
Struck by on-track equipment, Riding	14	4	9	.	1	.	.	.	.	.	.
Sudden, unexpected movement, other, Walking	14	5	1	6	.	2	.	.	.	.	.
Struck by object, Sitting	14	5	.	7	1	.	1	.	.	.	.
Struck by falling object, Loading/unloading	13	12	.	.	.	1	.	.	.	.	.
Overexertion, Moving	13	13	.	.	.	.	.	.	.	.	.
Slack adjustment during switching operation, Riding	13	13	.	.	.	.	.	.	.	.	.
Struck by object, Maintaining	13	6	.	.	3	1	.	3	.	.	.
Overexertion, Walking	13	11	.	2	.	.	.	.	.	.	.
Sudden/unexpected movement of on-track equipment, Sitting	13	10	.	3	.	.	.	.	.	.	.
Overexertion, Handling baggage	13	13	.	.	.	.	.	.	.	.	.
Sudden, unexpected movement, other, Standing	13	6	.	3	1	2	.	1	.	.	.
Collision - between on track equipment, Operating	13	12	.	.	.	1	.	.	.	.	.
Bitten/stung by bee, spider, other insect, Sitting	13	10	.	.	.	.	3	.	.	.	.
Caught in/compressed by other machinery, Walking	12	.	1	10	1	.	.	.	.	.	.
Overexertion, Repairing	12	12	.	.	.	.	.	.	.	.	.
Bodily function/sudden movement, e.g.,sneezing,twisting, Bending, stooping	12	11	.	.	.	.	1	.	.	.	.
Overexertion, Replacing	12	11	.	.	.	.	.	1	.	.	.
Struck by thrown or propelled object, Standing	12	10	.	.	.	2	.	.	.	.	.
Struck by falling object, Opening	12	11	.	.	.	1	.	.	.	.	.
Caught, crushed, pinched, other, Standing	12	9	.	2	1	.	.	.	.	.	.
Struck by on-track equipment, Crossing over	12	.	12	.	.	.	.	.	.	.	.
Overexertion, Closing	12	12	.	.	.	.	.	.	.	.	.
Slipped, fall, stumbled, other, Stepping over	12	10	1	.	.	.	.	1	.	.	.
Struck by object, Spiking (installation/removal)	12	11	.	.	.	.	.	1	.	.	.

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Overexertion, Adjusting, other	12	12									
Sudden/unexpected movement of vehicle, Sitting	12	9				2		1			
Struck against object, Driving (motor vehicle, forklift, etc.)	12	4	4		1	1	1	1			
Stepped on object, Stepped on	11	11									
Overexertion, Handling, other	11	11									
Slipped, fell, stumbled, etc. due to climatic condition, Climbing over/on	11	9			1	1					
Missed handhold, grabiron, step, etc., Getting off	11	4		5	1	1					
Overexertion, Spiking (installation/removal)	11	11									
Derailment, Riding	11	11									
Slipped, fell, stumbled, other, Ascending	11	8			2			1			
Caught, crushed, pinched, other, Getting off	11	4		5	1			1			
Overexertion, Getting on	11	11									
Bitten/stung by bee, spider, other insect, Walking	11	7					4				
Sudden/unexpected movement of on-track equipment, Walking	10	6		3			1				
Overexertion, Cleaning	10	10									
Caught in/compressed by hand tools, Using hand tool	10	9				1					
Overexertion, Pulling pin lifter/operating uncoupling	10	10									
Struck by object, Repairing	10	9						1			
Other (describe in narrative), Lifting other material	10	9				1					
Struck against object, Bending, stooping	10	10									
Missed handhold, grabiron, step, etc., Stepping down	10	8		1				1			
Sudden, unexpected movement, other, Riding	10	3	1		6						
Struck by thrown or propelled object, Spiking (installation/removal)	10	9								1	
Struck by on-track equipment, Climbing over/on	10	.	10								
Overexertion, Standing	10	10									
Slipped,fell,stumbled,etc. due to irregular surface, Stepping over	10	10									
Blowing/falling debris, Standing	10	8						1			1
Slipped, fell, stumbled, other, Carrying	10	7			1	1	1				
Other (describe in narrative), Cutting, other	10	10									
Other (describe in narrative), Riding	10	8	2								
Overexertion, Getting off	10	10									
Bodily function/sudden movement, e.g.,sneezing,twisting, Standing	10	9				1					
Struck against object, Using hand tool	10	10									
Collision - between on track equipment, Standing	10	1		9							

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Blowing/falling debris, Riding	10	1		9							
Slipped, fell, stumbled, other, Getting out	9	5		1	1	2					
Struck by on-track equipment, Jumping onto	9		9								
Defective/malfunctioning equipment, Lining switches	9	9									
Slipped fell stumbled etc. due to object,ballast, spike, etc., Stepped on	9	9									
Stepped on object, Getting off	9	8						1			
Struck by on-track equipment, Other (Narrative must be provided)	9	2	7								
Lost balance, Getting on	9	6	1	1	1						
Other (describe in narrative), Lining switches	9	9									
Bodily function/sudden movement, e.g. sneezing,twisting, Climbing over/on	9	9									
Bodily function/sudden movement, e.g. sneezing,twisting, Stepping down	9	8					1				
Struck by object, Handling, other	9	8				1					
Other (describe in narrative), Getting off	9	8		1							
Defective/malfunctioning equipment, Riding	9	8			1						
Overexertion, Stepping down	9	8		1							
Caught, crushed, pinched, other, Installing	9	9									
Sudden/unexpected movement of on-track equipment, Operating	9	9									
Missed handhold, grabiron, step, etc., Descending	9	7						2			
Struck by object, Operating	9	9									
Stepped on object, Stepping down	9	8						1			
Struck by object, Lifting other material	9	8						1			
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Descending	9	8				1					
Struck against object, Handling, other	9	8			1						
Struck against object, Climbing over/on	8	8									
Overexertion, Installing	8	8									
Bodily function/sudden movement, e.g. sneezing,twisting, Pulling	8	8									
Struck by falling object, Operating	8	5				2		1			
Other (describe in narrative), Using hand tool	8	8									
Collision/impact - auto, truck, bus, van, etc., Operating	8	4	1		1	2					
Sudden, unexpected movement, other, Opening	8	7				1					
Missed handhold, grabiron, step, etc., Walking	8	3		3	2						
Assaulted by other, Walking	8	4		1	1		2				
Slipped, fell, stumbled, other, Jumping from	8	2	4	2							
Struck against object, Cleaning	8	8									
Bodily function/sudden movement, e.g. sneezing,twisting, Getting off	8	8									
Struck by object, Riding	8	6		2							
Caught, crushed, pinched, other, Replacing	8	7						1			

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Sudden, unexpected movement, other, Maintaining	8	1			2	5					
Struck by falling object, Walking	8	4	1	1			1		1		
Caught, crushed, pinched, other, Maintaining	8	6				2					
Exposure to fumes - inhalation, Walking	8	8									
Struck against object, Getting on	8	6		2							
Bodily function/sudden movement, e.g. sneezing,twisting, Using hand tool	8	8									
Bodily function/sudden movement, e.g. sneezing,twisting, Lifting other material	8	7				1					
Struck by falling object, Adjusting, other	8	6		1				1			
Struck by object, Adjusting, other	8	5			1	2					
Exposure to fumes - inhalation, Sitting	8	8									
Needle puncture/prick/stick, Cleaning	7	6				1					
Other (describe in narrative), Sitting	7	4		2	1						
Struck by falling object, Cleaning	7	7									
Struck against object, Opening	7	7									
Overexertion, Reaching	7	6					1				
Lost balance, Bending, stooping	7	5			2						
Bodily function/sudden movement, e.g.,sneezing,twisting, Walking	7	6						1			
Slipped, fell, stumbled, etc. due to climatic condition, Stepping up	7	2			4						1
Slipped, fell, stumbled, other, Crossing over	7	3	1		3						
Blowing/falling debris, Walking	7	7									
Struck by object, Closing	7	7									
Defective/malfunctioning equipment, Sitting	7	5		1			1				
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Stepping over	7	7									
Caught, crushed, pinched, other, Lifting equipment (tools, parts, etc.)	7	7									
Other (describe in narrative), Pulling	7	6					1				
Sudden/unexpected movement of material, Loading/unloading	7	5			1			1			
Struck by object, Getting on	7	2		4	1						
Overexertion, Handling ties	7	7									
Overexertion, Operating	7	7									
Other (describe in narrative), Stepping down	7	7									
Other (describe in narrative), Opening	7	5		1				1			
Lost balance, Crossing over	7	2	4		1						
Overexertion, Handling car parts	7	7									
Defective/malfunctioning equipment, Getting off	7	7									
Struck against object, Getting off	7	5	1	1							
Struck by on-track equipment, Crossing or crawling under	7	.	7								
Caught, crushed, pinched, other, Operating	7	6				1					
Exposure to noise - single incident, Sitting	7	7									
Other (describe in narrative), Standing	7	7									
Struck by on-track equipment, Sleeping	7	.	7								

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Struck by object, Cutting, other	7	6						1			
Bitten/stung by bee, spider, other insect, Standing	7	6					1				
Struck by thrown or propelled object, Removing rail anchors/fasteners	7	7									
Overexertion, Stepping up	7	7									
Sudden/unexpected movement of vehicle, Standing	6	5				1					
Slipped, fell, stumbled, other, Maintaining	6					5		1			
Slipped, fell, stumbled, etc. due to climatic condition, Stepping over	6	6									
Exposure to chemicals - external, Walking	6	3							3		
Exposure to fumes - inhalation, Inspecting	6	6									
Caught, crushed, pinched, other, Pulling	6	5				1					
Sudden/unexpected movement of material, Pulling	6	5						1			
Slipped, fell, stumbled, other, Pulling	6	6									
Overexertion, Maintaining	6	4				1		1			
Struck against object, Reaching	6	6									
Overexertion, Adjusting coupler	6	6									
Sudden, unexpected movement, other, Operating	6	5						1			
Struck by falling object, Sitting	6	2		4							
Overexertion, Handling material, general	6	6									
Aggravated pre-existing condition, Walking	6	3		1	1			1			
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Running	6	4	1			1					
Bitten/stung by bee, spider, other insect, Sleeping	6						6				
Slipped,fell,stumbled,etc. due to irregular surface, Descending	6	1		1	4						
Sudden, unexpected movement, other, Driving (motor vehicle, forklift, etc.)	6				2	2	1	1			
Struck by thrown or propelled object, Riding	6	5							1		
Overexertion, Handling other track material/supplies	6	6									
Derailment, Sitting	6	1		5							
Derailment, Jumping from	6	6									
Struck by object, Bending, stooping	5	4						1			
Slipped, fell, stumbled, etc. due to climatic condition, Ascending	5	3			2						
Overexertion, Ascending	5	5									
Caught, crushed, pinched, other, Lifting other material	5	5									
Slipped,fell,stumbled,etc. on oil, grease,etc., Cleaning	5	5									
Slipped, fell, stumbled, etc. due to climatic condition, Standing	5	5									
Lost balance, Maintaining	5	1				2		2			

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY 8

06:45 Wednesday, May 18, 2005

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Struck against object, Cutting - other	5	5	.	.	.	.	.	.	.	.	.
Caught, - crushed, pinched, other, Inspecting	5	3	.	.	1	1	.	.	.	.	.
Sudden/unexpected movement of material, Standing	5	3	.	1	.	1	.	.	.	.	.
Struck by falling object, Lifting equipment (tools, parts, etc.)	5	2	.	.	.	1	.	2	.	.	.
On track equipment, other incidents, Operating	5	4	.	.	.	1	.	.	.	.	.
Slipped, fell, stumbled, etc. due to climatic condition, Getting out	5	5	.	.	.	.	.	.	.	.	.
Overexertion, Coupling air hose	5	5	.	.	.	.	.	.	.	.	.
Struck by on-track equipment, Bending, stooping	5	.	5	.	.	.	.	.	.	.	.
Sudden/Unexpected Movement of tools, Repairing	5	5	.	.	.	.	.	.	.	.	.
Caught in/crushed by materials, Lifting other material	5	4	.	.	.	1	.	.	.	.	.
Defective/malfunctioning equipment, Opening	5	5	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of material, Repairing	5	5	.	.	.	.	.	.	.	.	.
Repetitive motion - other (describe in narrative), Using hand tool	5	5	.	.	.	.	.	.	.	.	.
Caught in/crushed by materials, Loading/unloading	5	5	.	.	.	.	.	.	.	.	.
Bodily function/sudden movement, e.g., sneezing,twisting, Handbrakes, applying	5	5	.	.	.	.	.	.	.	.	.
Defective/malfunctioning equipment, Handbrakes, releasing	5	5	.	.	.	.	.	.	.	.	.
Struck by object, Other (Narrative must be provided)	5	4	.	.	.	.	.	1	.	.	.
Apprehending/removing from property, Arresting/apprehending/subduing	5	4	.	.	.	1	.	.	.	.	.
Caught in/compressed by powered hand tools, Using hand tool	5	5	.	.	.	.	.	.	.	.	.
Struck against object, Pulling	5	5	.	.	.	.	.	.	.	.	.
Struck by object, Installing	5	4	.	.	.	1	.	.	.	.	.
Struck by falling object, Adjusting coupler	5	5	.	.	.	.	.	.	.	.	.
Sudden, unexpected movement, other, Stepping down	5	3	.	1	.	1	.	.	.	.	.
Caught, crushed, pinched, other, Using hand tool	5	4	.	.	.	1	.	.	.	.	.
Struck against object, Repairing	5	4	.	.	.	.	.	1	.	.	.
Stepped on object, Descending	5	5	.	.	.	.	.	.	.	.	.
Aggravated pre-existing condition, Standing	5	1	.	1	2	.	.	1	.	.	.
Struck against object, Handbrakes, applying	5	5	.	.	.	.	.	.	.	.	.
Sudden/Unexpected Movement of tools, Pulling	5	4	.	.	.	.	.	1	.	.	.
Lost balance, Running	5	1	.	.	3	.	1	.	.	.	.
Blowing/falling debris, Grinding	5	5	.	.	.	.	.	.	.	.	.

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Bodily function/sudden movement, e.g. sneezing,twisting, Lifting equipment (tools, parts, etc.)	5	4						1			
Struck by thrown or propelled object, Repairing	5	2				3					
Lost balance, Stepping over	5	5									
Struck by thrown or propelled object, Grinding	5	5									
Sudden, unexpected movement, other, Handling, other	5	4			1						
Other (describe in narrative), Driving (motor vehicle, forklift, etc.)	5	2	2				1				
Struck against object, Inspecting	5	5									
Struck by on-track equipment, Operating	5	3	2								
Sudden, unexpected movement, other, Lifting equipment (tools, parts, etc.)	5	5									
Struck by object, Opening/closing angle cock	5	5									
Other (describe in narrative), Carrying	5	4				1					
Struck by object, Pulling	5	4				1					
Lost balance, Ascending	5	4			1						
Struck against object, Maintaining	5	1				3		1			
Exposure to noise - single incident, Operating	5	5									
Other (describe in narrative), Lifting equipment (tools, parts, etc.)	5	5									
Slipped, fell, stumbled, other, Jumping onto	5		5								
Struck by object, Getting off	5	1		4							
Exposure to welding light, Welding (includes field welding)	5	5									
Caught, crushed, pinched, other, Lining switches	5	5									
Struck against object, Loading/unloading	5	4			1						
Derailment, Standing	5	1		4							
Missed handhold, grabiron, step, etc., Getting on	5	2		2	1						
Struck by thrown or propelled object, Operating	5	5									
Struck by object, Coupling air hose	5	5									
Electrical shock, other (explain in narrative), Walking	5		5								
Struck by thrown or propelled object, Opening/closing angle cock	5	5									
Overexertion, Removing rail anchors/fasteners	5	4						1			
Struck against object, Operating	5	5									
Bitten/stung by bee, spider, other insect, Lining switches	5	5									
Lost balance, Cleaning	4	4									
Bodily function/sudden movement, e.g. sneezing,twisting, Lining switches	4	4									
Slipped, fell, stumbled, etc. due to climatic condition, Stepped on	4	3			1						
Bodily function/sudden movement, e.g. sneezing,twisting, Getting out	4	3				1					

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY 10

06:45 Wednesday, May 18, 2005

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Burned, Cutting rail	4	4									
Assaulted by other, Sitting	4	3			1						
Caught, crushed, pinched, other, Moving	4	4									
Struck by object, Cleaning	4	4									
Blowing/falling debris, Sitting	4	3					1				
Sudden, unexpected movement, other, Lining switches	4	4									
Slipped, fell, stumbled, etc. due to climatic condition, Lining switches	4	4									
Caught in/crushed by materials, Adjusting, other	4	3				1					
Bodily function/sudden movement, e.g. sneezing,twisting, Descending	4	3					1				
Sudden/Unexpected Movement of tools, Cutting, other	4	4									
Slipped, fell, stumbled, etc. due to climatic condition, Running	4	1			3						
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Lining switches	4	4									
Repetitive motion - work processes, Lifting equipment (tools, parts, etc.)	4	4									
Other (describe in narrative), Handbrakes, applying	4	4									
Struck by object, Lifting equipment (tools, parts, etc.)	4	4									
Exposure to chemicals - external, Standing	4	3			1						
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Stepping up	4	4									
Slipped, fell, stumbled, other, Repairing	4	4									
Collision/impact - auto, truck, bus, van, etc., Standing	4	3		1							
Lost balance, Using hand tool	4	3						1			
Defective/malfunctioning equipment, Getting on	4	4									
Caught in/compressed by other machinery, Riding	4	2			2						
Assaulted by coworker, Standing	4	3			1						
Slipped,fell,stumbled,etc. on oil, grease etc., Descending	4	3						1			
Overexertion, Sitting	4	3						1			
Other (describe in narrative), Grinding	4	4									
Sudden, unexpected movement, other, Reaching	4	4									
Other (describe in narrative), Spiking (installation/removal)	4	4									
Struck by thrown or propelled object, Applying rail anchor/fastener	4	4									
Slipped, fell, stumbled, other, Cleaning	4	4									
Exposure to chemicals - external, Cleaning	4	3				1					
Collision - between on track equipment, Riding	4	4									

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY 11
06:45 Wednesday, May 18, 2005

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Struck against object, Replacing	4	3	.	.		.	.	1	.	.	
Slipped, fell, stumbled, other, Stepped on	4	1	.	.	3	.	.	.	.	.	
Missed handhold, grabiron, step, etc., Climbing over/on	4	4	.	.	.	.	.	.	.	.	
Aggravated pre existing condition, Sitting	4	2	.	2	.	.	.	.	.	.	
Ran into object/equipment, Riding	4	1	2	.	.	.	1	.	.	.	
Ran into on-track equipment, Riding	4	3	1	.	.	.	.	.	.	.	
Caught, crushed, pinched, other, Pulling pin lifter/operating uncoupling	4	3	.	.	.	.	.	1	.	.	
Struck by object, Uncoupling air hose	4	4	.	.	.	.	.	.	.	.	
Other (describe in narrative), Climbing over/on	4	3	1	.	.	.	.	.	.	.	
Slipped, fell, stumbled, other, Pulling pin lifter/operating uncoupling	4	4	.	.	.	.	.	.	.	.	
Sudden, unexpected movement, other, Pulling	4	4	.	.	.	.	.	.	.	.	
Sudden/Unexpected Movement of tools, Removing rail anchors/fasteners	4	4	.	.	.	.	.	.	.	.	
Caught, crushed, pinched, other, Handling ties	4	4	.	.	.	.	.	.	.	.	
Struck by falling object, Handling, other	4	3	.	.	.	.	.	1	.	.	
Other (describe in narrative), Reaching	4	4	.	.	.	.	.	.	.	.	
Struck by on-track equipment, Jumping from	4	.	4	.	.	.	.	.	.	.	
Slipped,fell,stumbled,etc. due to irregular surface, Stepped on	4	4	.	.	.	.	.	.	.	.	
Slipped,fell,stumbled,etc. on oil, grease,etc., Stepping down	4	4	.	.	.	.	.	.	.	.	
Overexertion, Derail, applying	4	4	.	.	.	.	.	.	.	.	
Aggravated pre-existing condition, Lifting other material	4	4	.	.	.	.	.	.	.	.	
Derailment, Operating	4	4	.	.	.	.	.	.	.	.	
Struck by falling object, Replacing	4	4	.	.	.	.	.	.	.	.	
Slipped,fell,stumbled,etc. on oil,grease,etc., Stepping up	4	3	.	.	.	.	1	.	.	.	
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Carrying	4	4	.	.	.	.	.	.	.	.	
Caught in/crushed by materials, Handling ties	4	4	.	.	.	.	.	.	.	.	
Struck by object, Handling material, general	4	4	.	.	.	.	.	.	.	.	
Caught, crushed, pinched, other, Handling material, general	4	3	.	.	.	1	.	.	.	.	
Burned, Standing	4	2	.	2	.	.	.	.	.	.	
Sudden/unexpected movement of material, Lifting other material	4	3	.	.	.	1	.	.	.	.	
Missed handhold, grabiron, step, etc., Stepping up	4	3	1	.	.	.	.	.	.	.	
Struck by object, Cutting rail	4	4	.	.	.	.	.	.	.	.	
Slipped,fell,stumbled,etc. on oil, grease,etc., Getting off	4	4	.	.	.	.	.	.	.	.	
Bitten/stung by bee, spider, other insect, Maintaining	4	4	.	.	.	.	.	.	.	.	
Caught, crushed, pinched, other, Other (Narrative must be provided)	4	1	.	2	.	1	.	.	.	.	

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Struck by on-track equipment, Getting on	4	.	4	.	.	.	.	.	.	.	.
Struck against object, Getting in	4	3	.	1	.	.	.	.	.	.	.
Other (describe in narrative), Handbrakes, releasing	4	4	.	.	.	.	.	.	.	.	.
Struck against object, Getting out	4	3	.	.	.	.	1	.	.	.	.
Sudden/unexpected movement of material, Handling, other	4	3	.	.	.	1	.	.	.	.	.
Sudden, unexpected movement, other, Loading/unloading	4	4	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Climbing over/on	4	1	3	.	.	.	.	.	.	.	.
Other impacts - on track equipment, Riding	4	4	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, other, Pushing	4	1	.	.	2	1	.	.	.	.	.
Slipped,fell,stumbled etc. on oil, grease,etc., Handling, other	4	4	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, other, Lying down	4	.	3	.	1	.	.	.	.	.	.
Slipped, fell, stumbled, other, Handbrakes, releasing	4	4	.	.	.	.	.	.	.	.	.
Sudden, unexpected movement, other, Handbrakes, applying	4	4	.	.	.	.	.	.	.	.	.
Bumped, Walking	4	3	.	1	.	.	.	.	.	.	.
Defective/malfunctioning equipment, Adjusting coupler	4	4	.	.	.	.	.	.	.	.	.
Struck by thrown or propelled object, Sitting	4	4	.	.	.	.	.	.	.	.	.
Overexertion, Derail, removing	4	4	.	.	.	.	.	.	.	.	.
Repetitive motion - tools, Using hand tool	4	4	.	.	.	.	.	.	.	.	.
On track equipment, other incidents, Jumping from	4	4	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, other, Reaching	3	3	.	.	.	.	.	.	.	.	.
Rubbed, abraded, etc., Cleaning	3	3	.	.	.	.	.	.	.	.	.
Struck by falling object, Handling car parts	3	3	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Handling car parts	3	3	.	.	.	.	.	.	.	.	.
Overexertion, Handling locomotive parts	3	3	.	.	.	.	.	.	.	.	.
Bodily function/sudden movement, e.g., sneezing,twisting, Moving	3	3	.	.	.	.	.	.	.	.	.
Caught in/crushed by materials, Repairing	3	3	.	.	.	.	.	.	.	.	.
Slack action, draft, compressive buff/coupling, Standing	3	3	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, etc. due to climatic condition, Cleaning	3	2	.	.	.	1	.	.	.	.	.
Struck against object, Coupling air hose	3	3	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of material, Cutting, other	3	2	.	.	.	1	.	.	.	.	.
Aggravated pre-existing condition, Stepping up	3	3	.	.	.	.	.	.	.	.	.
Other (describe in narrative), Laying	3	1	2	.	.	.	.	.	.	.	.
Struck against object, Adjusting, other	3	3	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of material, Handling material, general	3	3	.	.	.	.	.	.	.	.	.

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Struck against object, Ascending	3	3	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to irregular surface, Stepping up	3	2	.	1	.	.	.	.	.	.	.
Struck against object, Stepping up	3	2	.	1	.	.	.	.	.	.	.
Lost balance, Getting out	3	1	.	.	.	1	.	1	.	.	.
Slipped, fell, stumbled, etc. due to climatic condition, Loading/unloading	3	2	.	.	1	.	.	.	.	.	.
Lost balance, Other (Narrative must be provided)	3	2	.	.	1	.	.	.	.	.	.
Bodily function/sudden movement, e.g. sneezing,twisting, Reaching	3	2	.	.	.	.	1	.	.	.	.
Slipped, fell, stumbled, etc. due to climatic condition, Coupling air hose	3	3	.	.	.	.	.	.	.	.	.
Struck by object, Welding (includes field welding)	3	2	.	.	.	.	.	1	.	.	.
Caught, crushed, pinched, other, Cutting, other	3	3	.	.	.	.	.	.	.	.	.
Struck by object, Replacing	3	3	.	.	.	.	.	.	.	.	.
Stabbing, knifing, etc., Cutting, other	3	2	.	.	.	.	1	.	.	.	.
Bumped, Standing	3	2	.	.	.	.	1	.	.	.	.
Struck by falling object, Bending, stooping	3	3	.	.	.	.	.	.	.	.	.
Struck by object, Grinding	3	2	.	.	1	.	.	.	.	.	.
Other (describe in narrative), Repairing	3	3	.	.	.	.	.	.	.	.	.
Caught in/compressed by hand tools, Repairing	3	3	.	.	.	.	.	.	.	.	.
Other (describe in narrative), Operating	3	3	.	.	.	.	.	.	.	.	.
Struck by object, Handling car parts	3	3	.	.	.	.	.	.	.	.	.
Repetitive motion - work processes, Bending, stooping	3	3	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, other, Using hand tool	3	3	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Servicing	3	2	.	.	.	.	.	1	.	.	.
Struck by object, Using, other	3	3	.	.	.	.	.	.	.	.	.
Overexertion, Descending	3	3	.	.	.	.	.	.	.	.	.
Burned, Welding (includes field welding)	3	2	.	.	.	.	.	1	.	.	.
Other (describe in narrative), Cleaning	3	3	.	.	.	.	.	.	.	.	.
Aggravated pre-existing condition, Pulling	3	3	.	.	.	.	.	.	.	.	.
Defective/malfunctioning equipment, Standing	3	3	.	.	.	.	.	.	.	.	.
Struck against object, Handling material, general	3	2	.	.	.	1	.	.	.	.	.
Slipped, fell, stumbled, other, Closing	3	2	.	.	.	.	.	1	.	.	.
Horseplay, practical joke, etc., Standing	3	1	2	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Getting on	3	.	.	3	.	.	.	.	.	.	.
Other (describe in narrative), Bending, stooping	3	2	.	.	.	.	.	1	.	.	.
Struck by object, Ascending	3	.	.	3	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Reaching	3	3	.	.	.	.	.	.	.	.	.
Defective/malfunctioning equipment, Handbrakes, applying	3	3	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, etc. due to climatic condition, Pulling pin lifter/operating uncoupling	3	3	.	.	.	.	.	.	.	.	.

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY 14
06:45 Wednesday, May 18, 2005

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Bodily function/sudden movement, e.g., sneezing twisting, Coupling air hose	3	3									
Slipped,fell,stumbled etc. due to object,ballast, spike, etc., Ascending	3	3									
Lost balance, Pulling	3	2						1			
Sudden/unexpected movement of vehicle, Operating	3	2				1					
Caught in/compressed by other machinery, Using, other	3			3							
Slipped, fell, stumbled, other, Using, other	3			2	1						
Struck by falling object, Lifting other material	3	2				1					
Burned, Sitting	3			2			1				
Struck by object, Handling other track material/supplies	3	3									
Ran into object/equipment, Driving (motor vehicle, forklift, etc.)	3	2	1								
Lost balance, Loading/unloading	3	1			2						
Struck against object, Handbrakes, releasing	3	3									
Slipped on object, Stepping over	3	3									
Other (describe in narrative), Descending	3	3									
Other (describe in narrative), Jumping from	3	2	1								
Other (describe in narrative), Stepping up	3	3									
Sudden, unexpected movement, other, Using hand tool	3	3									
Needle puncture/prick/stick, Reaching	3	3									
Caught in/crushed by materials, Closing	3	3									
Sudden/unexpected movement of material, Handling rail	3	3									
Slipped,fell,stumbled etc. due to irregular surface, Getting on	3	1		1	1						
Burned, Using hand tool	3	3									
Struck by object, Inspecting	3	3									
Slipped, fell, stumbled, other, Loading/unloading	3	3									
Sudden/unexpected movement of vehicle, Walking	3	1		2							
Struck by falling object, Closing	3	3									
Sudden/Unexpected Movement of tools, Spiking (installation/removal)	3	3									
Struck by object, Handling locomotive parts	3	3									
Caught, crushed, pinched, other, Handbrakes, releasing	3	3									
Caught in/compressed by other machinery, Closing	3			2		1					
Bodily function/sudden movement, e.g., sneezing,twisting, Opening	3	3									
Caught in/compressed by other machinery, Getting on	3			3							

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Missed handhold, grabiron, step, etc., Ascending	3	1		2							
Lost balance, Installing	3	3									
Struck against object, Using, other	3	1		1	1						
Sudden/unexpected movement of material, Driving (motor vehicle, forklift, etc.)	3				1	1		1			
Overexertion, Lining, other	3	3									
Needle puncture/prick/stick, Handling, other	3	3									
Sudden/unexpected movement of material, Carrying	3	3									
Bitten/stung by bee, spider, other insect, Riding	3	3									
Overexertion, Handling rail	3	3									
Struck against object, Installing	3	3									
Climatic conditions, other (e.g., high winds), Walking	3	1					2				
Other (describe in narrative), Closing	3	2		1							
Other (describe in narrative), Getting on	3	2		1							
Sudden, unexpected movement, other, Bending, stooping	3	3									
Sudden/unexpected movement of on-track equipment, Jumping from	3	3									
Aggravated pre-existing condition, Replacing	3	3									
Slipped,fell,stumbled,etc. due to irregular surface, Crossing over	3	2			1						
Other impacts - on track equipment, Operating	3	3									
Sudden/unexpected movement of on-track equipment, Maintaining	3	1				2					
Sudden/unexpected movement of material, Sitting	3	3									
Blowing/falling debris, Handbrakes, applying	3	3									
Sudden, unexpected movement, other, Spiking (installation/removal)	3	3									
Sudden, unexpected movement, other, Repairing	3	2						1			
Struck against object, Other (Narrative must be provided)	3	2						1			
Sudden, unexpected movement, other, Descending	3	3									
Caught in/compressed by other machinery, Pushing	3	1		2							
Burned, Cutting, other	3	3									
Struck against object, Spiking (installation/removal)	3	3									
Defective/malfunctioning equipment, Operating	3	3									
Other (describe in narrative), Handling, other	3	3									
Caught in/compressed by hand tools, Spiking (installation/removal)	3	3									
Lost balance, Stepped on	3	1			2						
Struck by object, Laying	3		3								

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Overexertion, Getting in	3	2		1							
Other (describe in narrative), Welding (includes field welding)	3	2						1			
Bitten/stung by bee, spider, other insect, Inspecting	3	3									
Other (describe in narrative), Stepping over	3	3									
Slipped,fell,stumbled,etc. on oil, grease,etc., Getting on	3	1		2							
Burned, Handling, other	3	3									
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Inspecting	3	3									
Climatic condition, exposure to environmental heat, Walking	3	3									
Struck by falling object, Handling material, general	3	2				1					
Struck by on-track equipment, Stepping down	3	2		1							
Sudden, unexpected movement, other, Jumping from	3	2			1						
Exposure to fumes - inhalation, Maintaining	3					3					
Assaulted by coworker, Sitting	3	3									
Bodily function/sudden movement, e.g. sneezing,twisting, Adjusting, other	3	3									
Slipped, fell, stumbled, other, Laying	3		2			1					
Other (describe in narrative), Inspecting	3	3									
Struck against object, Descending	3	3									
Struck by object, Removing rail anchors/fasteners	3	3									
Lost balance, Handbrakes, applying	3	3									
Stepped on object, Stepping up	3	3									
Slack action, draft, compressive buff/coupling, Sitting	3	3									
Slipped,fell,stumbled,etc. due to irregular surface, Running	3	1			2						
Aggravated pre-existing condition, Lifting equipment (tools, parts, etc.)	2	2									
Repetitive motion - other (describe in narrative), Other (Narrative must be provided)	2	1					1				
Struck by object, Descending	2	2									
Repetitive motion - typing, keyboard, etc., Using, other	2	2									
Slipped, fell, stumbled, etc. due to climatic condition, Maintaining	2	2									
Blowing/falling debris, Repairing	2	2									
Sudden/unexpected movement of on-track equipment, Cleaning	2	2									
Slipped,fell,stumbled,etc. due to irregular surface, Opening	2	1						1			
Sudden/Unexpected Movement of tools, Using, other	2	2									

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Caught, crushed, pinched, other, Getting out	2	2	.	.	.	.	.	.	.	.	.
Struck by object, Applying rail anchor/fastener	2	2	.	.	.	.	.	.	.	.	.
Sudden/unexpected Movement of tools, Handbrakes, releasing	2	2	.	.	.	.	.	.	.	.	.
Other (describe in narrative), Handling ties	2	2	.	.	.	.	.	.	.	.	.
Lost balance, Lining switches	2	2	.	.	.	.	.	.	.	.	.
Struck by falling object, Handling ties	2	2	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Adjusting coupler	2	2	.	.	.	.	.	.	.	.	.
Ran into on-track equipment, Driving (motor vehicle, forklift, etc.)	2	.	2	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, etc. due to climatic condition, Inspecting	2	2	.	.	.	.	.	.	.	.	.
Repetitive motion - other (describe in narrative), Riding	2	2	.	.	.	.	.	.	.	.	.
Caught in/compressed by other machinery, Other (Narrative must be provided)	2	2	.	.	.	.	.	.	.	.	.
Caught in/compressed by other machinery, Repairing	2	2	.	.	.	.	.	.	.	.	.
Blowing/falling debris, Operating	2	2	.	.	.	.	.	.	.	.	.
Ran into on-track equipment, Running	2	.	2	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, etc. due to climatic condition, Reaching	2	2	.	.	.	.	.	.	.	.	.
Sudden/Unexpected Movement of tools, Operating	2	2	.	.	.	.	.	.	.	.	.
Caught in/compressed by powered hand tools, Using, other	2	2	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to irregular surface, Lifting equipment (tools, parts, etc.)	2	1	.	.	.	1	.	.	.	.	.
Sudden, unexpected movement, other, Closing	2	2	.	.	.	.	.	.	.	.	.
Lost balance, Handling, other	2	2	.	.	.	.	.	.	.	.	.
Struck by falling object, Moving	2	1	.	.	.	.	.	1	.	.	.
Slipped, fell, stumbled, other, Handbrakes, applying	2	2	.	.	.	.	.	.	.	.	.
Blowing/falling debris, Cleaning	2	2	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to irregular surface, Ascending	2	1	.	.	1	.	.	.	.	.	.
Slipped, fell, stumbled, etc. due to climatic condition, Closing	2	2	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of material, Handling car parts	2	2	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Handling other track material/supplies	2	2	.	.	.	.	.	.	.	.	.
Repetitive motion - work processes, Operating	2	2	.	.	.	.	.	.	.	.	.
Thrill seeking, Walking	2	.	2	.	.	.	.	.	.	.	.
Aggravated pre-existing condition, Stepping down	2	2	.	.	.	.	.	.	.	.	.
Bumped, Other (Narrative must be provided)	2	2	.	.	.	.	.	.	.	.	.

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Electrical shock, other (explain in narrative), Maintaining	2	2									
Struck by falling object, Handling baggage	2	2									
Lost balance, Jumping from	2		1		1						
Thrill seeking, Jumping from	2				2						
Slack adjustment during switching operation, Operating	2	2									
Slipped,fell,stumbled,etc. on oil, grease etc., Getting out	2	2									
Caught, crushed, pinched, other, Handling wheels/trucks	2	2									
Slipped, fell, stumbled, etc. due to climatic condition, Lifting equipment (tools, parts, etc.)	2	2									
Bodily function/sudden movement, e.g. sneezing,twisting, Sitting	2				1	1					
Lost balance, Moving	2					2					
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Crossing over	2	2									
Rubbed, abraded, etc., Riding	2	1				1					
Struck by falling object, Coupling air hose	2	2									
Caught Between Material, Removing rail anchors/fasteners	2	2									
Lost balance, Servicing	2	1						1			
Repetitive motion - work processes, Other (Narrative must be provided)	2	2									
Slipped, fell, stumbled, etc. due to climatic condition, Installing	2	2									
Burned, Servicing	2	2									
Lost balance, Opening	2	1						1			
Caught in/crushed by materials, Handling other track material/supplies	2	2									
Caught, crushed, pinched, other, Bending, stooping	2	2									
Defective/malfunctioning equipment, Stepping down	2	2									
Thrill seeking, Jumping onto	2		2								
Struck against object, Running	2				2						
Sudden/unexpected movement of on-track equipment, Opening	2	2									
Other (describe in narrative), Adjusting coupler	2	2									
Blowing/falling debris, Replacing	2	1						1			
Caught, crushed, pinched, other, Stepping down	2	1			1						
Caught, crushed, pinched, other, Handling tie plates	2	1						1			
Struck by on-track equipment, Crossing between	2		2								
Caught, crushed, pinched, other, Derail applying	2	2									

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Caught In/compressed by other machinery, Inspecting	2	2									
Struck by object, Moving	2	2									
Slipped, fell, stumbled, other, Lifting other material	2	1				1					
Assaulted by other, Arresting/apprehending/subduing	2	2									
Rubbed, abraded, etc., Standing	2	2									
Caught, crushed, pinched, other, Cleaning	2	2									
Defective/malfunctioning equipment, Getting out	2	2									
Slipped, fell, stumbled, etc. due to climatic condition, Pulling	2	2									
Caught Between Equipment, Riding	2	2									
Struck by falling object, Riding	2	2									
Slipped,fell,stumbled,etc. due to irregular surface, Cutting vegetation	2	1						1			
Sudden release of air, Opening/closing angle cock	2	2									
Struck by falling object, Inspecting	2	2									
Overexertion, Other (Narrative must be provided)	2	2									
Struck by falling object, Stepping down	2	1							1		
Slipped, fell, stumbled, other, Inspecting	2	1						1			
On track equipment, other incidents, Other (Narrative must be provided)	2	1	1								
Slipped, fell, stumbled, other, Coupling air hose	2	2									
Burned, Maintaining	2	1				1					
Caught, crushed, pinched, other, Chaining, cabling car or locomotive	2	2									
Sudden/unexpected movement of material, Handling ties	2	2									
Ran into object/equipment, Running	2	.	2								
Aggravated pre-existing condition, Installing	2	2									
Struck by object, Pushing	2	1				1					
Needle puncture/prick/stick, Sitting	2	2									
Sudden, unexpected movement, other, Replacing	2	1						1			
Sudden/unexpected movement of on-track equipment, Inspecting	2	2									
Struck against object, Lifting equipment (tools, parts, etc.)	2	1						1			
Sudden, unexpected movement, other, Getting on	2	1		1							
Sudden/unexpected movement of material, Cutting vegetation	2	2									
Aggravated pre-existing condition, Riding	2	1		1							
Slipped,fell,stumbled,etc. due to irregular surface, Carrying	2	1				1					

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Other (describe in narrative), Adjusting, other	2	2									
Climatic conditions, other (e.g., high winds), Handling material, general	2	2									
Struck by on-track equipment, Getting off	2	1	1								
Bitten/stung by bee, spider, other insect, Applying rail anchor/fastener	2	2									
Slipped, fell, stumbled, other, Digging, excavating	2	2									
Other impacts - on track equipment, Walking	2	1		1							
Defective/malfunctioning equipment, Pulling pin lifter/operating uncoupling	2	2									
Sudden/unexpected movement of material, Replaning	2	2									
Sudden, unexpected movement, other, Applying rail anchor/fastener	2	2									
Slipped, fell, stumbled, other, Installing	2	2									
Caught, crushed, pinched, other, Driving (motor vehicle, forklift, etc.)	2	2									
Aggravated pre-existing condition, Handbrakes, releasing	2	2									
Struck by thrown or propelled object, Opening	2	1				1					
Caught in/compressed by powered hand tools, Grinding	2	1				1					
Slipped,fell,stumbled,etc. on oil, grease,etc., Stepping over	2	2									
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Getting on	2			1	1						
Bitten/stung by bee, spider, other insect, Operating	2	2									
On track equipment, other incidents, Opening	2	1					1				
Blowing/falling debris, Adjusting, other	2	2									
Other (describe in narrative), Handling other track material/supplies	2	2									
Struck by object, Handbrakes, releasing	2	2									
Sudden/unexpected movement of on-track equipment, Handbrakes, applying	2	2									
Lost balance, Lifting equipment (tools, parts, etc.)	2	2									
Caught in/crushed by materials, Opening	2	1		1							
Assaulted by other, Other (Narrative must be provided)	2	2									
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Bending, stooping	2	2									
Struck by thrown or propelled object, Cutting, other	2	2									
Thrill seeking, Getting off	2		2								
Sudden/unexpected movement of material, Handling locomotive parts	2	2									
Overexertion, Using, other	2	2									

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Repetitive motion - tools, Spiking (installation/removal)	2	2	.	.	.	.	.	.	.	.	.
Bodily function/sudden movement, e.g.,sneezing,twisting, Spiking (installation/removal)	2	2	.	.	.	.	.	.	.	.	.
Derailment, Getting off	2	2	.	.	.	.	.	.	.	.	.
Struck by object, Stopping up	2	.	.	1	.	1	.	.	.	.	.
Ran into object/equipment, Walking	2	1	1	.	.	.	.	.	.	.	.
Other (describe in narrative), Using, other	2	2	.	.	.	.	.	.	.	.	.
Aggravated pre-existing condition, Bending, stooping	2	2	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Removing rail anchors/fasteners	2	2	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, other, Replacing	2	2	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Cleaning	2	2	.	.	.	.	.	.	.	.	.
Struck by falling object, Installing	2	2	.	.	.	.	.	.	.	.	.
Highway-rail collision/impact, Sitting	2	.	1	1	.	.	.	.	.	.	.
Struck by falling object, Pulling	2	2	.	.	.	.	.	.	.	.	.
Bitten/stung by bee, spider, other insect, Coupling air hose	2	2	.	.	.	.	.	.	.	.	.
Lost balance, Pushing	2	1	.	.	.	.	.	1	.	.	.
Rubbed, abraded, etc., Handling rail	2	2	.	.	.	.	.	.	.	.	.
Repetitive motion - work processes, Spiking (installation/removal)	2	2	.	.	.	.	.	.	.	.	.
Struck by thrown or propelled object, Coupling air hose	2	2	.	.	.	.	.	.	.	.	.
Overexertion, Inspecting	2	2	.	.	.	.	.	.	.	.	.
Blowing/falling debris, Coupling air hose	2	2	.	.	.	.	.	.	.	.	.
Lost balance, Inspecting	2	2	.	.	.	.	.	.	.	.	.
Struck by thrown or propelled object, Welding (includes field welding)	2	2	.	.	.	.	.	.	.	.	.
Struck by falling object, Pulling pin lifter/operating uncoupling	2	2	.	.	.	.	.	.	.	.	.
Sudden/Unexpected Movement of tools, Other (Narrative must be provided)	2	2	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of on-track equipment, Pulling pin lifter/operating uncoupling	2	2	.	.	.	.	.	.	.	.	.
Other (describe in narrative), Ascending	2	2	.	.	.	.	.	.	.	.	.
Overexertion, Opening/closing angle cock	2	2	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, other, Handling rail	2	2	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to irregular surface, Getting out	2	2	.	.	.	.	.	.	.	.	.
Pushed/shoved into/against, Descending	2	.	.	1	1	.	.	.	.	.	.
Bumped, Bending, stooping	2	2	.	.	.	.	.	.	.	.	.
Bodily function/sudden movement, e.g.,sneezing,twisting, Handling material, general	2	2	.	.	.	.	.	.	.	.	.

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Struck by falling object, Reaching	2	1	.	1	.	.	.	.	.	.	.
Struck by thrown or propelled object, Cutting vegetation	2	2	.	.	.	.	.	.	.	.	.
Struck by falling object, Cutting vegetation	2	2	.	.	.	.	.	.	.	.	.
Sudden, unexpected movement, other, Using, other	2	1	.	1	.	.	.	.	.	.	.
Stabbing, knifing, etc., Using hand tool	2	2	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to irregular surface, Pulling pin lifter/operating uncoupling	2	2	.	.	.	.	.	.	.	.	.
Climatic condition, exposure to environmental heat, Sitting	2	2	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Sitting	2	1	.	.	1	.	.	.	.	.	.
Caught Between Material, Handling ties	2	1	.	.	.	.	.	1	.	.	.
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Coupling air hose	2	2	.	.	.	.	.	.	.	.	.
Climatic condition, exposure to environmental heat, Inspecting	2	2	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of material, Pushing	2	2	.	.	.	.	.	.	.	.	.
Struck against object, Moving	2	2	.	.	.	.	.	.	.	.	.
Bumped, Repairing	2	2	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of material, Spiking (installation/removal)	2	2	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Loading/unloading	2	1	.	.	.	1	.	.	.	.	.
Overexertion, Jumping from	2	2	.	.	.	.	.	.	.	.	.
Lost balance, Operating	2	1	.	.	.	.	1	.	.	.	.
Electrical shock, other (explain in narrative), Standing	2	2	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, etc. due to climatic condition, Carrying	2	1	.	.	.	.	.	1	.	.	.
Bitten/stung by bee, spider, other insect, Bending, stooping	2	2	.	.	.	.	.	.	.	.	.
Burned, Washing	2	2	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of on-track equipment, Reaching	2	2	.	.	.	.	.	.	.	.	.
Struck by falling object, Maintaining	2	1	.	.	.	.	.	.	.	1	.
Overexertion, Cutting, other	2	2	.	.	.	.	.	.	.	.	.
Struck by thrown or propelled object, Driving (motor vehicle, forklift, etc.)	2	2	.	.	.	.	.	.	.	.	.
Other (describe in narrative), Pushing	2	2	.	.	.	.	.	.	.	.	.
Other (describe in narrative), Handling material, general	2	2	.	.	.	.	.	.	.	.	.
Sudden/Unexpected Movement of tools, Installing	2	1	.	.	.	.	.	1	.	.	.
Collision/impact - auto, truck, bus, van, etc., Hauling	2	1	.	.	.	.	.	1	.	.	.
Struck by thrown or propelled object, Handbrakes, releasing	2	2	.	.	.	.	.	.	.	.	.

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Repetitive motion - tools, Pulling	2	2	.	.	.	.	.	.	.	.	.
Struck by object, Stepping down	2	1	.	1	.	.	.	.	.	.	.
Lost balance, Spiking (installation/removal)	2	2	.	.	.	.	.	.	.	.	.
Struck by object, Handling ties	2	2	.	.	.	.	.	.	.	.	.
Struck by Other Remote Control Locomotive, Sitting	2	2	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, - other, Crossing or crawling under	2	.	2	.	.	.	.	.	.	.	.
Exposure to poisonous plants, Walking	2	2	.	.	.	.	.	.	.	.	.
Blowing/falling debris, Cutting, other	2	2	.	.	.	.	.	.	.	.	.
Aggravated pre-existing condition, Getting on	2	2	.	.	.	.	.	.	.	.	.
Other (describe in narrative), Digging, excavating	2	2	.	.	.	.	.	.	.	.	.
Rubbed, abraded, etc., Installing	2	2	.	.	.	.	.	.	.	.	.
Exposure to chemicals - external, Inspecting	2	2	.	.	.	.	.	.	.	.	.
Caught in/crushed by materials, Handling car parts	2	2	.	.	.	.	.	.	.	.	.
Sudden/Unexpected Movement of tools, Maintaining	2	1	.	.	.	1	.	.	.	.	.
Aggravated pre-existing condition, Loading/unloading	2	2	.	.	.	.	.	.	.	.	.
Sudden release of air, Standing	2	2	.	.	.	.	.	.	.	.	.
Lost balance, Removing rail anchors/fasteners	2	1	1	.	.	.	.	.	.	.	.
Struck against object, Stepping down	2	1	.	.	1	.	.	.	.	.	.
Bodily function/sudden movement, e.g. sneezing,twisting, Getting in	2	.	.	.	.	.	2	.	.	.	.
Slipped, fell, stumbled, other, Operating	2	2	.	.	.	.	.	.	.	.	.
Overexertion, Grinding	2	2	.	.	.	.	.	.	.	.	.
Caught in/crushed by materials, Installing	2	2	.	.	.	.	.	.	.	.	.
Bitten/stung by bee, spider, other insect, Opening	2	2	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, - other, Coupling air hose	2	1	.	.	.	.	.	1	.	.	.
Aggravated pre-existing condition, Handbrakes, applying	2	2	.	.	.	.	.	.	.	.	.
Pushed/shoved into/against, Standing	2	.	.	2	.	.	.	.	.	.	.
Slipped,fell,stumbled etc. due to object,ballast, spike, etc., Lifting equipment (tools, parts, etc.)	2	2	.	.	.	.	.	.	.	.	.
Overexertion, Handbrakes, other	2	2	.	.	.	.	.	.	.	.	.
Sudden, unexpected movement, other, Cutting, other	2	2	.	.	.	.	.	.	.	.	.
Struck by falling object, Carrying	2	2	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Pushing	2	2	.	.	.	.	.	.	.	.	.
Sudden/Unexpected Movement of tools, Handling, other	2	2	.	.	.	.	.	.	.	.	.
Struck by object, Sanding	2	2	.	.	.	.	.	.	.	.	.
Exposure to chemicals - external, Riding	2	2	.	.	.	.	.	.	.	.	.
Struck against object, Pushing	2	1	.	.	.	.	.	1	.	.	.

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Bitten/stung by bee, spider, other insect, Lifting equipment (tools, parts, etc.)	2	2									
Lost balance, Carrying	2	2									
Other (describe in narrative), Installing	2	2									
Defective/malfunctioning equipment, Maintaining	2	2									
Exposure to fumes - inhalation, Cleaning	2	2									
Blowing/falling debris, Using hand tool	2	2									
Bitten/stung by bee, spider, other insect, Driving (motor vehicle, forklift, etc.)	2	2									
Slipped,fell,stumbled,etc. on oil, grease,etc., Crossing over	2	2									
Burned, Cleaning	2	2									
Struck by falling object, Other (Narrative must be provided)	2	2									
Sudden/Unexpected Movement of tools, Cutting vegetation	2	2									
Struck by object, Handbrakes, applying	2	2									
Overexertion, Coupling electric cables	2	2									
Caught, crushed, pinched, other, Opening/closing angle cock	2	2									
Lost balance, Repairing	2	2									
Sudden/unexpected movement of material, Adjusting, other	2	2									
Struck by thrown or propelled object, Maintaining	2	1					1				
Ran into object/equipment, Operating	2	2									
Slipped, fell, stumbled, other, Handling material, general	2	2									
Sudden/unexpected movement of on-track equipment, Coupling air hose	2	2									
Slipped,fell,stumbled,etc. on oil, grease,etc., Climbing over/on	2	2									
Lost balance, Handbrakes, releasing	2	2									
Caught, crushed, pinched, other, Getting in	2	1			1						
Struck by object, Reaching	2	2									
Struck by on-track equipment, Coupling air hose	2	2									
Struck against object, Stepped on	2	1			1						
Climatic conditions, other (e.g., high winds), Riding	2	2									
Lost balance, Sitting	2	1		1							
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Applying rail anchor/fastener	2	2									
Slipped, fell, stumbled, other, Handling, other	2	2									
Climatic conditions, other (e.g., high winds), Handling, other	2					2					
Lost balance, Adjusting, other	2	1						1			

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Sudden, unexpected movement, other, Handling locomotive parts	2	2	.	.	.	.	.	.	.	.	.
Sudden/Unexpected Movement of tools, Pushing	2	1	.	.	.	.	.	1	.	.	.
Sudden, unexpected movement, other, Climbing over/on	2	2	.	.	.	.	.	.	.	.	.
Other (describe in narrative), Getting in	2	2	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Installing	2	2	.	.	.	.	.	.	.	.	.
Struck by falling object, Getting on	2	2	.	.	.	.	.	.	.	.	.
Lost balance, Reaching	2	2	.	.	.	.	.	.	.	.	.
Needle puncture/prick/stick, Walking	2	2	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, other, Adjusting, other	2	1	.	.	.	1	.	.	.	.	.
Slipped, fell, stumbled, other, Other (Narrative must be provided)	2	2	.	.	.	.	.	.	.	.	.
Pushed/shoved into/against, Walking	2	.	.	.	2	.	.	.	.	.	.
Sudden, unexpected movement, other, Lifting other material	2	2	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Handling rail	2	2	.	.	.	.	.	.	.	.	.
Struck by object, Cutting vegetation	2	.	.	.	.	1	.	1	.	.	.
Sudden/unexpected movement of material, Using hand tool	2	2	.	.	.	.	.	.	.	.	.
Exposure to noise - single incident, Replacing	1	1	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, etc. due to climatic condition, Adjusting, other	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. on oil, grease,etc., Getting in	1	1	.	.	.	.	.	.	.	.	.
Exposure to chemicals - external, Maintaining	1	1	.	.	.	.	.	.	.	.	.
Ran into object/equipment, Sitting	1	.	.	.	.	.	.	.	1	.	.
Slipped, fell, stumbled, etc. due to climatic condition, Crossing over	1	1	.	.	.	.	.	.	.	.	.
Pushed/shoved onto, Pushing	1	1	.	.	.	.	.	.	.	.	.
Needle puncture/prick/stick, Closing	1	1	.	.	.	.	.	.	.	.	.
Caught in/crushed by materials, Pulling	1	1	.	.	.	.	.	.	.	.	.
Pushed/shoved into/against, Maintaining	1	.	.	.	.	1	.	.	.	.	.
Caught in/crushed by materials, Maintaining	1	.	.	.	.	1	.	.	.	.	.
Bitten by animal, Standing	1	.	.	.	.	.	1	.	.	.	.
Rubbed, abraded, etc., Handling material, general	1	1	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, etc. due to climatic condition, Crossing between	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Opening/closing angle cock	1	1	.	.	.	.	.	.	.	.	.
Bodily function/sudden movement, e.g., sneezing,twisting, Riding	1	.	.	1	.	.	.	.	.	.	.
Slipped, fell, stumbled, other, Fueling	1	1	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of on-track equipment, Digging, excavating	1	1	.	.	.	.	.	.	.	.	.

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Missed handhold, grabiron, step, etc., Pulling pin lifter/operating uncoupling	1	1									
Caught in/crushed by materials, Using hand tool	1	1									
Bumped, Handling, other	1	1									
Aggravated pre-existing condition, Carrying	1	1									
Missed handhold, grabiron, step, etc., Crossing between	1	1									
Climatic condition, exposure to environmental cold, Repairing	1	1									
Exposure to fumes - inhalation, Coupling air hose	1	1									
Struck by thrown or propelled object, Handling rail	1	1									
Slipped, fell, stumbled, etc. due to climatic condition, Spiking (installation/removal)	1	1									
Missed handhold, grabiron, step, etc., Getting out	1	1									
Caught Between Machinery, Installing	1	1									
Pushed/shoved into/against, Stepping down	1	1									
Repetitive motion - work processes, Pulling	1	1									
Electrical shock, other (explain in narrative), Inspecting	1	1									
Caught in/compressed by hand tools, Loading/unloading	1	1									
Struck against object, Washing	1	1									
Lost balance, Stepping up	1				1						
Sudden/unexpected movement of on-track equipment, Pulling	1	1									
Overexertion, Derail, other	1	1									
Slipped, fell, stumbled, etc. due to climatic condition, Adjusting coupler	1	1									
Caught in/crushed by materials, Lifting equipment (tools, parts, etc.)	1	1									
Caught in/compressed by hand tools, Applying rail anchor/fastener	1	1									
Burned, Climbing over/on	1		1								
Slipped, fell, stumbled, etc. due to climatic condition, Opening	1	1									
Struck by object, Climbing over/on	1	1									
Aggravated pre-existing condition, Other (Narrative must be provided)	1	1									
Pushed/shoved into/against, Getting on	1	1									
Collision/impact - auto, truck, bus, van, etc., Jumping onto	1	1									
Sudden/unexpected movement of material, Getting on	1	1									
Pushed/shoved from, Lifting equipment (tools, parts, etc.)	1	1									

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Slipped,fell,stumbled,etc. due to irregular surface, Grinding	1	1	.	.	.	.	.	.	.	.	.
Struck by falling object, Getting out	1	1	.	.	.	.	.	.	.	.	.
Struck by on-track equipment, Inspecting	1	1	.	.	.	.	.	.	.	.	.
Pushed/shoved onto, Handling locomotive parts	1	1	.	.	.	.	.	.	.	.	.
Collision/impact - auto, truck, bus, van, etc., Getting out	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Cutting vegetation	1	1	.	.	.	.	.	.	.	.	.
Struck by on-track equipment, Stepping up	1	.	1	.	.	.	.	.	.	.	.
Defective/malfunctioning equipment, Climbing over/on	1	1	.	.	.	.	.	.	.	.	.
Exposure to fumes - inhalation, Washing	1	1	.	.	.	.	.	.	.	.	.
Struck by thrown or propelled object, Handling locomotive parts	1	1	.	.	.	.	.	.	.	.	.
Struck against object, Lifting other material	1	1	.	.	.	.	.	.	.	.	.
Struck against object, Arresting/apprehending/subduing	1	1	.	.	.	.	.	.	.	.	.
Assaulted by coworker, Handling, other	1	1	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, other, Arresting/apprehending/subduing	1	1	.	.	.	.	.	.	.	.	.
Struck by object, Carrying	1	1	.	.	.	.	.	.	.	.	.
Bodily function/sudden movement, e.g. sneezing,twisting, Laying	1	.	.	1	.	.	.	.	.	.	.
Defective/malfunctioning equipment, Driving (motor vehicle, forklift, etc.)	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to irregular surface, Coupling air hose	1	1	.	.	.	.	.	.	.	.	.
Struck by thrown or propelled object, Installing	1	1	.	.	.	.	.	.	.	.	.
Defective/malfunctioning equipment, Grinding	1	1	.	.	.	.	.	.	.	.	.
Pushed/shoved from, Standing	1	1	.	.	.	.	.	.	.	.	.
Bodily function/sudden movement, e.g. sneezing,twisting, Handling car parts	1	1	.	.	.	.	.	.	.	.	.
Sudden, unexpected movement, other, Pushing	1	.	.	.	.	.	.	1	.	.	.
Struck by thrown or propelled object, Handling material, general	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Handling other track material/supplies	1	1	.	.	.	.	.	.	.	.	.
Overexertion, Jumping onto	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. on oil, grease,etc., Jumping from	1	1	.	.	.	.	.	.	.	.	.
Struck by Other Remote Control Locomotive, Operating	1	1	.	.	.	.	.	.	.	.	.
Bitten by animal, Inspecting	1	1	.	.	.	.	.	.	.	.	.
Lost balance, Getting in	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. on oil, grease,etc., Standing	1	1	.	.	.	.	.	.	.	.	.

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Burned, Using, other	1	1									
Defective/malfunctioning equipment, Spiking (installation/removal)	1	1									
Slipped, fell, stumbled, etc. due to climatic condition, Other (Narrative must be provided)	1	1									
Other (describe in narrative), Pulling pin lifter/operating uncoupling	1	1									
Sustained viewing, Welding (includes field welding)	1	1									
Sudden/unexpected movement of vehicle, Getting out	1	1									
Slack action, draft, compressive buff/coupling, Other (Narrative must be provided)	1	1									
Caught, crushed, pinched, other, Cutting rail	1	1									
Slipped, fell, stumbled, etc. due to climatic condition, Coupling electric cables	1	1									
Stepped on object, Inspecting	1	1									
Struck by object, Chaining, cabling car or locomotive	1	1									
Slipped, fell, stumbled, other, Sleeping	1				1						
Sudden/unexpected movement of material, Bending, stooping	1	1									
Aggravated pre-existing condition, Adjusting, other	1	1									
Caught Between Material, Reaching	1	1									
Sudden, unexpected movement, other, Coupling steam hose	1	1									
Defective/malfunctioning equipment, Handling, other	1	1									
Needle puncture/prick/stick, Adjusting, other	1	1									
Slipped, fell, stumbled, etc. due to climatic condition, Pushing	1	1									
Repetitive motion - work processes, Cleaning	1	1									
Aggravated pre-existing condition, Using hand tool	1	1									
Slipped,fell,stumbled,etc. due to irregular surface, Inspecting	1	1									
Repetitive motion - tools, Lifting equipment (tools, parts, etc.)	1	1									
Sudden release of air, Using hand tool	1							1			
Other (describe in narrative), Opening/closing angle cock	1	1									
Pushed/shoved from, Lining switches	1	1									
Other impacts - on track equipment, Laying	1		1								
Collision - between on track equipment, Reaching	1	1									
Repetitive motion - work processes, Maintaining	1	1									
Electrical shock from hand tool, Using hand tool	1	1									

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Climatic condition, exposure to environmental cold, Riding	1	.	1	.	.	.	.	.	.	.	.
Caught Between Equipment, Crossing over	1	.	.	.	1	.	.	.	.	.	.
Struck by Other Remote Control Locomotive, Standing	1	1	.	.	.	.	.	.	.	.	.
Caught Between Material, Handling locomotive parts	1	.	.	.	.	.	.	1	.	.	.
Sudden/unexpected movement of material, Cutting rail	1	1	.	.	.	.	.	.	.	.	.
Caught Between Machinery, Lifting equipment (tools, parts, etc.)	1	1	.	.	.	.	.	.	.	.	.
Caught Between Machinery, Adjusting, other	1	1	.	.	.	.	.	.	.	.	.
Caught in/compressed by other machinery, Stepped on	1	.	.	1	.	.	.	.	.	.	.
Blowing/falling debris, Driving (motor vehicle, forklift, etc.)	1	1	.	.	.	.	.	.	.	.	.
Struck by on-track equipment, Pulling	1	.	.	.	.	.	.	1	.	.	.
Assaulted by other, Jumping from	1	.	.	1	.	.	.	.	.	.	.
Bumped, Getting in	1	1	.	.	.	.	.	.	.	.	.
Slack action, draft, compressive buff/coupling, Operating	1	1	.	.	.	.	.	.	.	.	.
Burned, Operating	1	1	.	.	.	.	.	.	.	.	.
Repetitive motion - work processes, Sitting	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Crossing between	1	1	.	.	.	.	.	.	.	.	.
Repetitive motion - work processes, Lining switches	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to irregular surface, Riding	1	.	.	.	1	.	.	.	.	.	.
Repetitive motion - work processes, Handling other track material/supplies	1	1	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of on-track equipment, Handling material, general	1	1	.	.	.	.	.	.	.	.	.
Sudden/Unexpected Movement of tools, Carrying	1	1	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of vehicle, Loading/unloading	1	1	.	.	.	.	.	.	.	.	.
Blowing/falling debris, Descending	1	1	.	.	.	.	.	.	.	.	.
Sudden, unexpected movement, other, Handling poles	1	1	.	.	.	.	.	.	.	.	.
Bumped, Operating	1	1	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of material, Handbrakes, releasing	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Loading/unloading	1	1	.	.	.	.	.	.	.	.	.
Other (describe in narrative), Running	1	.	1	.	.	.	.	.	.	.	.
Pushed/shoved into/against, Fueling	1	1	.	.	.	.	.	.	.	.	.
Bodily function/sudden movement, e.g. sneezing,twisting, Washing	1	1	.	.	.	.	.	.	.	.	.

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Sudden/unexpected movement of material, Installing	1	1									
Struck by falling object, Cutting, other	1	1									
Slipped, fell, stumbled, etc. due to climatic condition, Riding	1	1									
Sudden/unexpected movement of on-track equipment, Handling tie plates	1							1			
Repetitive motion - tools, Repairing	1	1									
Overexertion, Hauling	1	1									
Slipped,fell,stumbled,etc. due to irregular surface, Coupling electric cables	1	1									
Sudden, unexpected movement, other, Moving	1	1									
Caught in/compressed by other machinery, Installing	1	1									
Sudden/unexpected movement of vehicle, Running	1	1									
Lost balance, Replacing	1	1									
Repetitive motion - other (describe in narrative), Operating	1	1									
Rubbed, abraded, etc., Operating	1	1									
Pushed/shoved into/against, Adjusting coupler	1						1				
Caught in/compressed by other machinery, Bending, stooping	1	1									
Struck by falling object, Using, other	1	1									
Slipped,fell,stumbled,etc. due to irregular surface, Standing	1	1									
Caught in/crushed by materials, Carrying	1	1									
Caught in/crushed by materials, Handling locomotive parts	1	1									
Slack action, draft, compressive buff/coupling, Adjusting coupler	1	1									
Caught, crushed, pinched, other, Crossing over	1							1			
Pushed/shoved into/against, Handling ties	1	1									
Sudden/unexpected movement of on-track equipment, Getting out	1			1							
Rubbed, abraded, etc., Reaching	1	1									
Exposure to fumes - inhalation, Using hand tool	1	1									
Struck against object, Closing	1	1									
Struck by thrown or propelled object, Digging, excavating	1	1									
Sudden/Unexpected Movement of tools, Grinding	1	1									
Sudden/unexpected movement of vehicle, Reaching	1	1									
Caught Between Equipment, Jumping from	1		1								
Bumped, Getting on	1	1									
Assaulted by coworker, Sanding	1				1						

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Bite/stung by bee, spider, other insect, Handling locomotive parts	1	1									
Overexertion, Driving (motor vehicle, forklift, etc.)	1	1									
Assaulted by other, Stepping up	1	1									
Exposure to noise - single incident, Walking	1						1				
Caught, crushed, pinched, other, Handling baggage	1	1									
Stepped on object, Lifting equipment (tools, parts, etc.)	1	1									
Sudden, unexpected movement, other, Digging, excavating	1	1									
Struck against object, Laying	1		1								
Bodily function/sudden movement, e.g. sneezing, twisting, Pushing	1	1									
Exposure to fumes - inhalation, Handling, other	1	1									
Blowing/falling debris, Servicing	1						1				
Sudden, unexpected movement, other, Washing	1							1			
Struck by thrown or propelled object, Adjusting, other	1					1					
Defective/malfunctioning equipment, Stepping up	1	1									
Caught Between Material, Loading/unloading	1	1									
Climatic condition, exposure to environmental heat, Maintaining	1							1			
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Moving	1	1									
Bumped, Riding	1	1									
Caught Between Equipment, Walking	1	1									
Defective/malfunctioning equipment, Servicing	1	1									
Caught Between Equipment, Crossing between	1		1								
Sudden/unexpected movement of on-track equipment, Getting off	1	1									
Collision - between on track equipment, Jumping from	1	1									
Struck by object, Uncoupling electric cables	1	1									
Climatic conditions, other (e.g., high winds), Lining switches	1	1									
Blowing/falling debris, Using, other	1	1									
On track equipment, other incidents, Repairing	1	1									
Collision - between on track equipment, Other (Narrative must be provided)	1	1									
Sudden, unexpected movement, other, Handling wheels/trucks	1	1									
Pushed/shoved into/against, Arresting/apprehending/subduing	1	1									
Caught in/compressed by hand tools, Handling other track material/supplies	1	1									

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Repetitive motion - work processes, Handling material, general	1	1									
Repetitive motion - work processes, Pushing	1	1									
Repetitive motion - other (describe in narrative), Lifting other material	1	1									
Caught in/compressed by hand tools, Other (Narrative must be provided)	1	1									
Struck against object, Handling ties	1	1									
Defective/malfunctioning equipment, Derail, removing	1							1			
Pushed/shoved into/against, Grinding	1	1									
Pushed/shoved into/against, Pushing	1	1									
Apprehending/removing from property, Inspecting	1	1									
Sudden, unexpected movement, other, Stepped on	1							1			
Sudden/unexpected movement of vehicle, Stepping down	1			1							
Pushed/shoved from, Jumping onto	1				1						
Assaulted by other, Stepping down	1	1									
Caught Between Equipment, Opening	1	1									
Caught, crushed, pinched, other, Handling poles	1	1									
Struck by falling object, Opening/closing angle cock	1	1									
Overexertion, Handling tie plates	1	1									
On track equipment, other incidents, Sitting	1	1									
Caught in/compressed by other machinery, Handbrakes, releasing	1	1									
Sudden, unexpected movement, other, Handbrakes, releasing	1	1									
Overexertion, Sanding	1	1									
Lost balance, Handling material, general	1	1									
Stepped on object, Pulling pin lifter/operating uncoupling	1	1									
Caught in/crushed in excavation, land slide, cave-in, etc., Inspecting	1	1									
Bitten by animal, Walking	1	1									
On track equipment, other incidents, Opening/closing angle cock	1	1									
Struck by object, Sleeping	1			1							
Derailment, Walking	1			1							
Overexertion, Getting out	1						1				
Stepped on object, Getting on	1	1									
Bodily function/sudden movement, e.g. sneezing, twisting, Maintaining	1	1									
Missed handhold, grabiron, step, etc., Crossing over	1	1									

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Struck by thrown or propelled object, Using, other	1	1									
Repetitive motion - work processes, Welding (includes field welding)	1	1									
Struck by thrown or propelled object, Pulling	1	1									
Burned, Opening	1	1									
Sudden/unexpected movement of on-track equipment, Sanding	1	1									
Slipped,fell, stumbled etc. due to object,ballast, spike, etc., Closing	1	1									
Struck by thrown or propelled object, Coupling electric cables	1	1									
Aggravated pre-existing condition, Adjusting coupler	1	1									
Sudden/unexpected movement of material, Laying	1	1									
On track equipment, other incidents, Handbrakes, applying	1	1									
Bitten/stung by bee, spider, other insect, Adjusting, other	1							1			
Lost balance, Closing	1	1									
Bitten by animal, Flagging	1	1									
Caught in/compressed by hand tools, Bending, stooping	1	1									
Ran into on-track equipment, Operating	1	1									
Struck by thrown or propelled object, Walking	1	1									
Slipped,fell,stumbled,etc. due to irregular surface, Handling ties	1	1									
Struck by object, Lining switches	1	1									
Slipped, fell, stumbled, etc. due to climatic condition, Adjusting drawbar	1	1									
Sudden/unexpected movement of on-track equipment, Other (Narrative must be provided)	1		1								
Sudden/unexpected movement of on-track equipment, Opening/closing angle cock	1	1									
Struck by falling object, Handling rail	1	1									
Collision - between on track equipment, Laying	1		1								
Overexertion, Using hand signals	1	1									
Bitten/stung by bee, spider, other insect, Reaching	1	1									
Ran into on-track equipment, Repairing	1	1									
Assaulted by other, Ascending	1	1									
Caught in/compressed by hand tools, Servicing	1							1			
Struck by falling object, Applying rail anchor/fastener	1	1									
Assaulted by coworker, Cleaning	1	1									
On track equipment, other incidents, Loading/unloading	1	1									
Blowing/falling debris, Cutting vegetation	1	1									

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Sudden/unexpected movement of material, Climbing over/on	1							1			
Pushed/shoved into/against, Moving	1	1									
Sudden/unexpected movement of on-track equipment, Stepping down	1	1									
Caught in/crushed by materials, Handling tie plates	1		1								
Stepped on object, Running	1	1									
Lost balance, Jumping onto	1		1								
Overexertion, Riding	1	1									
Bodily function/sudden movement, e.g. sneezing,twisting, Derail, removing	1	1									
Caught Between Equipment, Getting on	1		1								
Exposure to fumes - inhalation, Opening	1	1									
Caught in/compressed by other machinery, Operating	1	1									
Caught Between Machinery, Stepping down	1			1							
Caught in/compressed by other machinery, Stepping up	1			1							
Other (describe in narrative), Handling rail	1	1									
Sudden/unexpected movement of material, Removing rail anchors/fasteners	1	1									
Lost balance, Chaining, cabling car or locomotive	1	1									
Stepped on object, Arresting/apprehending/subduing	1	1									
Sudden/unexpected movement of on-track equipment, Stepping up	1	1									
Slipped,fell,stumbled,etc. on oil, grease etc., Inspecting	1	1									
Caught in/compressed by other machinery, Getting out	1				1						
Ran into on-track equipment, Walking	1		1								
Sudden/unexpected movement of vehicle, Repairing	1					1					
Collision - between on track equipment, Handling locomotive parts	1	1									
Stabbing, knifing, etc., Bending, stooping	1	1									
Exposure to chemicals - external, Opening	1	1									
Slipped,fell,stumbled,etc. on oil, grease etc., Coupling air hose	1	1									
Bodily function/sudden movement, e.g. sneezing,twisting, Carrying	1	1									
Stabbing, knifing, etc., Repairing	1	1									
Climatic condition, exposure to environmental heat, Standing	1	1									
Bodily function/sudden movement, e.g. sneezing,twisting, Driving (motor vehicle, forklift, etc.)	1						1				

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Struck by Own Remote Control Locomotive, Standing	1	1									
Caught Between Machinery, Sitting	1					1					
Sudden, unexpected movement, other, Carrying	1					1					
Sudden/Unexpected Movement of tools, Applying rail anchor/fastener	1	1									
Slipped, fell, stumbled, other, Uncoupling air hose	1					1					
Cave in, slide, etc., Walking	1	1									
Missed handhold, grabiron, step, etc., Other (Narrative must be provided)	1	1									
Aggravated pre-existing condition, Operating	1	1									
Struck by on-track equipment, Handbrakes, applying	1	1									
Missed handhold, grabiron, step, etc., Riding	1	1									
Caught Between Material, Handling rail	1	1									
Struck against object, Uncoupling electric cables	1	1									
Electrical shock, other (explain in narrative), Handling rail	1	1									
Aggravated pre-existing condition, Moving	1	1									
Sudden, unexpected movement, other, Adjusting, other	1	1									
Pushed/shoved into/against, Pulling	1	1									
Sudden/unexpected movement of on-track equipment, Using switches	1	1									
Slipped,fell,stumbled,etc. on oil, grease,etc., Pushing	1	1									
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Pushing	1	1									
Blowing/falling debris, Using hand signals	1	1									
Other (describe in narrative), Maintaining	1	1									
Cave in, slide, etc., Using hand tool	1	1									
Caught in/compressed by hand tools, Cutting, other	1	1									
Missed handhold, grabiron, step, etc., Stepping over	1	1									
Slack action, draft, compressive buff/coupling, Getting off	1	1									
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Spiking (installation/removal)	1	1									
Sudden/Unexpected Movement of tools, Standing	1	1									
Repetitive motion - other (describe in narrative), Pulling	1	1									
Climatic condition, exposure to environmental heat, Handling other track material/supplies	1	1									
Electrical shock, other (explain in narrative), Other (Narrative must be provided)	1	1									

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Sudden/Unexpected Movement of tools, Lifting equipment (tools, parts, etc.)	1	1									
Rubbed, abraded, etc., Descending	1	1									
Slipped,fell,stumbled,etc. due to irregular surface, Lifting other material	1					1					
Caught in/crushed by materials, Handling wheels/trucks	1	1									
Collision/impact - auto, truck, bus, van, etc., Digging, excavating	1	1									
Sudden, unexpected movement, other, Cutting vegetation	1					1					
Caught in/compressed by other machinery, Spiking (installation/removal)	1	1									
Repetitive motion - work processes, Handbrakes, applying	1	1									
Defective/malfunctioning equipment, Ascending	1	1									
Bodily function/sudden movement, e.g.,sneezing,twisting, Handling, other	1						1				
Struck by object, Handling tie plates	1	1									
Climatic conditions, other (e.g., high winds), Standing	1			1							
Electrical shock, other (explain in narrative), Pulling	1	1									
Exposure to chemicals - external, Handling, other	1	1									
Bodily function/sudden movement, e.g.,sneezing,twisting, Other (Narrative must be provided)	1	1									
Exposure to chemicals - external, Sitting	1	1									
Repetitive motion - other (describe in narrative), Opening	1	1									
Other (describe in narrative), Getting out	1	1									
Caught in/crushed by materials, Other (Narrative must be provided)	1	1									
Caught in/compressed by hand tools, Handling ties	1	1									
Missed handhold, grabiron, step, etc., Jumping onto	1		1								
Caught Between Material, Handling, other	1					1					
Rubbed, abraded, etc., Getting on	1	1									
Rubbed, abraded, etc., Handling other track material/supplies	1	1									
Struck by falling object, Handling locomotive parts	1	1									
Slipped,fell,stumbled,etc. due to irregular surface, Lining switches	1	1									
Repetitive motion - work processes, Handling tie plates	1	1									

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

06:45 Wednesday, May 18, 2005

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Caught, crushed, pinched, other, Adjusting drawbar	1	1									
On track equipment, other incidents, Adjusting, other	1	1									
Repetitive motion - work processes, Carrying	1	1									
Rubbed, abraded, etc., Pulling	1	1									
Exposure to noise - single incident, Opening/closing angle cock	1	1									
Struck against object, Jumping from	1		1								
Other (describe in narrative), Lying down	1		1								
Electrical shock, other (explain in narrative), Reaching	1	1									
Stepped on object, Grinding	1	1									
Burned, Handling car parts	1	1									
Horseplay, practical joke, etc., Sitting	1						1				
Bodily function/sudden movement, e.g., sneezing,twisting, Jumping from	1	1									
Stepped on object, Repairing	1	1									
Collision/impact - auto, truck, bus, van, etc., Walking	1	1									
Other impacts - on track equipment, Standing	1	1									
Bitten by animal, Handling, other	1	1									
Sudden/unexpected movement of material, Moving	1	1									
Struck by object, Flagging	1	1									
Exposure to chemicals - external, Operating	1	1									
Repetitive motion - work processes, Using, other	1	1									
Sudden/unexpected movement of material, Stepping down	1	1									
Assaulted by other, Bending, stooping	1	1									
Exposure to chemicals - external, Washing	1					1					
Sudden, unexpected movement, other, Handling material, general	1	1									
Struck by on-track equipment, Handling wheels/trucks	1	1									
Bodily function/sudden movement, e.g., sneezing,twisting, Getting on	1	1									
Bumped, Handbrakes, applying	1	1									
Caught Between Material, Standing	1	1									
Other impacts - on track equipment, Sitting	1	1									
Exposure to fumes - inhalation, Other (Narrative must be provided)	1	1									
Bodily function/sudden movement, e.g., sneezing,twisting, Handbrakes, releasing	1	1									
Caught in/compressed by hand tools, Operating	1	1									
Sudden, unexpected movement, other, Installing	1	1									
Assaulted by coworker, Inspecting	1	1									

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Assaulted by coworker, Other (Narrative must be provided)	1	1	.	.	.	.	.	.	.	.	.
Slipped fell stumbled etc. due to object ballast, spike, etc., Operating	1	1	.	.	.	.	.	.	.	.	.
Struck by on-track equipment, Reaching	1	.	1	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, other, Lining switches	1	1	.	.	.	.	.	.	.	.	.
Aggravated pre existing condition, Pushing	1	1	.	.	.	.	.	.	.	.	.
Bitten/stung by bee, spider, other insect, Installing	1	1	.	.	.	.	.	.	.	.	.
Struck by thrown or propelled object, Uncoupling air hose	1	1	.	.	.	.	.	.	.	.	.
Exposure to chemicals - external, Handbrakes, releasing	1	1	.	.	.	.	.	.	.	.	.
Slipped fell,stumbled,etc. due to irregular surface, Bending, stooping	1	.	.	.	.	.	.	1	.	.	.
Slipped fell,stumbled etc. on oil, grease,etc., Loading/unloading	1	1	.	.	.	.	.	.	.	.	.
Electrical shock due to contact with 3rd rail, catenary, pantograph, Digging, excavating	1	1	.	.	.	.	.	.	.	.	.
Caught in/crushed by materials, Getting off	1	.	.	1	.	.	.	.	.	.	.
Caught Between Material, Moving	1	1	.	.	.	.	.	.	.	.	.
Blowing/falling debris, Handling ties	1	1	.	.	.	.	.	.	.	.	.
Blowing/falling debris, Pulling	1	1	.	.	.	.	.	.	.	.	.
Blowing/falling debris, Installing	1	1	.	.	.	.	.	.	.	.	.
Climatic condition, exposure to environmental heat, Other (Narrative must be provided)	1	1	.	.	.	.	.	.	.	.	.
Exposure to chemicals - external, Other (Narrative must be provided)	1	1	.	.	.	.	.	.	.	.	.
Struck by falling object, Handling other track material/supplies	1	1	.	.	.	.	.	.	.	.	.
Assaulted by other, Cleaning	1	1	.	.	.	.	.	.	.	.	.
Caught in/crushed by materials, Handling material, general	1	1	.	.	.	.	.	.	.	.	.
Burned, Adjusting, other	1	1	.	.	.	.	.	.	.	.	.
Caught, crushed, pinched, other, Grinding	1	1	.	.	.	.	.	.	.	.	.
Stepped on object, Standing	1	.	.	.	.	.	1	.	.	.	.
Pushed/shoved into/against, Sitting	1	1	.	.	.	.	.	.	.	.	.
Caught in/crushed by materials, Derail, removing	1	1	.	.	.	.	.	.	.	.	.
Bitten/stung by bee, spider, other insect, Cutting vegetation	1	1	.	.	.	.	.	.	.	.	.
Pushed/shoved into/against, Lifting other material	1	.	.	.	.	.	.	1	.	.	.
Collision/impact - auto, truck, bus, van, etc., Other (Narrative must be provided)	1	.	.	.	1	.	.	.	.	.	.
Climatic condition, exposure to environmental heat, Handling rail	1	1	.	.	.	.	.	.	.	.	.
Thrill seeking, Driving (motor vehicle, forklift, etc.)	1	.	1	.	.	.	.	.	.	.	.

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Sudden/unexpected movement of on-track equipment, Descending	1			1							
Exposure to poisonous plants, Cutting vegetation	1	1									
Defective/malfunctioning equipment, Closing	1	1									
Rubbed, abraded, etc., Welding (includes field welding)	1	1									
Struck by falling object, Using hand tool	1	1									
Caught Between Material, Lifting equipment (tools, parts, etc.)	1							1			
Caught in/compressed by other machinery, Handling tie plates	1	1									
Caught in/compressed by powered hand tools, Cutting rail	1	1									
Collision - between on track equipment, Driving (motor vehicle, forklift, etc.)	1	1									
Lost balance, Laying	1		1								
Struck by object, Derail, removing	1	1									
Exposure to chemicals - external, Fueling	1	1									
Caught Between Equipment, Standing	1	1									
Defective/malfunctioning equipment, Jumping from	1	1									
Struck by falling object, Driving (motor vehicle, forklift, etc.)	1								1		
Struck by falling object, Flagging	1				1						
Exposure to poisonous plants, Sitting	1	1									
Stepped on object, Handling baggage	1	1									
Caught, crushed, pinched, other, Flagging	1	1									
Struck against object, Sanding	1	1									
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Using hand tool	1	1									
Caught in/crushed by materials, Replacing	1	1									
Rubbed, abraded, etc., Getting off	1	1									
Exposure to chemicals - external, Using hand tool	1	1									
Bitten/stung by bee, spider, other insect, Pulling pin lifter/operating uncoupling	1	1									
Exposure to chemicals - external, Lying down	1						1				
Caught, crushed, pinched, other, Spiking (installation/removal)	1	1									
Highway-rail collision/impact, Riding	1				1						
Sudden/unexpected movement of material, Handling other track material/supplies	1	1									
Slipped, fell, stumbled, other, Adjusting drawbar	1	1									
Caught in/compressed by powered hand tools, Pulling pin lifter/operating uncoupling	1	1									
Bitten/stung by bee, spider, other insect, Moving	1	1									

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Shot, Operating	1	1	.	.	.	.	.	.	.	.	.
Sudden release of air, Coupling air hose	1	1	.	.	.	.	.	.	.	.	.
Missed handhold, grabiron, step, etc., Handling car parts	1	1	.	.	.	.	.	.	.	.	.
Derailment, Other (Narrative must be provided)	1	1	.	.	.	.	.	.	.	.	.
Repetitive motion - tools, Replacing	1	1	.	.	.	.	.	.	.	.	.
Other (describe in narrative), Jumping onto	1	.	1	.	.	.	.	.	.	.	.
Caught in/compressed by other machinery, Maintaining	1	1	.	.	.	.	.	.	.	.	.
Sudden/Unexpected Movement of tools, Reaching	1	1	.	.	.	.	.	.	.	.	.
Sudden, unexpected movement, other, Handling car parts	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to irregular surface, Cutting, other	1	1	.	.	.	.	.	.	.	.	.
Stepped on object, Pulling	1	1	.	.	.	.	.	.	.	.	.
Repetitive motion - other (describe in narrative), Bending, stooping	1	1	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of on-track equipment, Climbing over/on	1	.	1	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to object ballast, spike, etc., Handling, other	1	1	.	.	.	.	.	.	.	.	.
Caught in/compressed by other machinery, Handling ties	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to irregular surface, Pushing	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to object ballast, spike, etc., Digging, excavating	1	1	.	.	.	.	.	.	.	.	.
Blowing/falling debris, Cutting rail	1	1	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of vehicle, Climbing over/on	1	1	.	.	.	.	.	.	.	.	.
Blowing/falling debris, Other (Narrative must be provided)	1	1	.	.	.	.	.	.	.	.	.
Repetitive motion - other (describe in narrative), Driving (motor vehicle, forklift, etc.)	1	1	.	.	.	.	.	.	.	.	.
Overexertion, Cutting rail	1	1	.	.	.	.	.	.	.	.	.
Sudden/unexpected movement of material, Other (Narrative must be provided)	1	1	.	.	.	.	.	.	.	.	.
Other, (describe in narrative), Loading/unloading	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. on oil, grease,etc., Stepped on	1	1	.	.	.	.	.	.	.	.	.
Exposure to noise - single incident, Standing	1	.	.	.	.	.	.	1	.	.	.
Slipped,fell,stumbled,etc. due to irregular surface, Pulling	1	1	.	.	.	.	.	.	.	.	.
Slack action, draft, compressive buff/coupling, Crossing between	1	1	.	.	.	.	.	.	.	.	.
Bumped, Installing	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to irregular surface, Cleaning	1	1	.	.	.	.	.	.	.	.	.

(Continued)

	Total	Worker on duty - employee	Traspassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Slipped, fell, stumbled, other, Cutting, other	1	1									
Bitten/stung by bee, spider, other insect, Stepped on	1	1									
Struck by object, Handling rail	1	1									
Bitten/stung by bee, spider, other insect, Digging, excavating	1	1									
Bitten/stung by bee, spider, other insect, Lifting other material	1	1									
Horseplay, practical joke, etc., Running	1		1								
Other impacts - on track equipment, Jumping from	1	1									
Caught Between Material, Lifting other material	1	1									
Other impacts - on track equipment, Pushing	1	1									
Sudden/Unexpected Movement of tools, Washing	1	1									
Caught Between Machinery, Grinding	1	1									
Repetitive motion - work processes, Getting on	1	1									
Slack action, draft, compressive buff/coupling, Getting on	1	1									
Caught in/crushed in excavation, land slide, cave-in, etc., Sitting	1	1									
Struck by object, Pulling pin lifter/operating uncoupling	1	1									
Bitten/stung by bee, spider, other insect, Getting off	1	1									
Slipped,fell,stumbled,etc. due to irregular surface, Other (Narrative must be provided)	1	1									
Repetitive motion - work processes, Applying rail anchor/fastener	1	1									
Sudden release of air, Other (Narrative must be provided)	1	1									
Struck by thrown or propelled object, Other (Narrative must be provided)	1	1									
Repetitive motion - work processes, Handling, other	1	1									
Blowing/falling debris, Getting on	1	1									
Blowing/falling debris, Inspecting	1	1									
Caught Between Machinery, Loading/unloading	1					1					
Repetitive motion - tools, Removing rail anchors/fasteners	1	1									
Aggravated pre-existing condition, Getting out	1						1				
Caught in/compressed by other machinery, Descending	1	1									
Slipped, fell, stumbled, other, Washing	1							1			
Sudden, unexpected movement, other, Sanding	1	1									
Overexertion, Handling wheels/trucks	1	1									
Ran into object/equipment, Standing	1	1									
Slipped,fell,stumbled,etc. due to object ballast, spike, etc., Washing	1	1									

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Caught in/compressed by other machinery, Cleaning	1	1									
Caught, crushed, pinched, other, Handling locomotive parts	1	1									
Blowing/falling debris, Stepping up	1	1									
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Cutting in	1	1									
Bodily function/sudden movement, e.g.,sneezing,twisting, Stepping over	1	1									
Rubbed, abraded, etc., Handling, other	1	1									
Bodily function/sudden movement, e.g.,sneezing,twisting, Cleaning	1	1									
Bodily function/sudden movement, e.g.,sneezing,twisting, Handling rail	1	1									
Aggravated pre-existing condition, Handling tie plates	1	1									
Struck by thrown or propelled object, Replacing	1	1									
Struck by falling object, Welding (includes field welding)	1	1									
Repetitive motion - work processes, Lifting other material	1	1									
Defective/malfunctioning equipment, Washing	1	1									
Rubbed, abraded, etc., Stepping down	1	1									
Slipped,fell,stumbled,etc. due to irregular surface, Uncoupling electric cables	1	1									
Bitten/stung by bee, spider, other insect, Cutting, other	1	1									
Ran into object/equipment, Stepping up	1	1									
Repetitive motion - other (describe in narrative), Adjusting, other	1	1									
Electrical shock due to contact with 3rd rail, catenary, pantograph, Driving (motor vehicle, forklift, etc.)	1					1					
Other (describe in narrative), Crossing over	1		1								
Overexertion, Uncoupling electric cables	1	1									
Slipped,fell,stumbled,etc. on oil, grease,etc., Handbrakes, applying	1	1									
Slipped,fell,stumbled,etc. due to irregular surface, Climbing over/on	1	1									
Exposure to chemicals - external, Servicing	1				1						
Lost balance, Pulling pin lifter/operating uncoupling	1	1									
Caught Between Material, Closing	1	1									
Caught in/compressed by hand tools, Handling rail	1	1									
Slipped,fell,stumbled,etc. on oil, grease,etc., Bending, stooping	1							1			
Assaulted by other, Riding	1	1									
Sudden/Unexpected Movement of tools, Coupling electric cables	1	1									

(Continued)

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Exposure to chemicals - external, Handling ties	1	1									
Sudden/unexpected movement of vehicle, Handling, other	1							1			
Caught Between Machinery, Uncoupling electric cables	1	1									
Cave in, slide, etc., Stepping down	1	1									
Slipped,fell,stumbled,etc. due to irregular surface, Maintaining	1	1									
Bodily function/sudden movement, e.g. sneezing,twisting, Operating	1	1									
Slack action, draft, compressive buff/coupling, Stepping up	1	1									
Caught, crushed, pinched, other, Derail, other	1	1									
Missed handhold, grabiron, step, etc., Jumping from	1		1								
Struck by object, Lining, other	1				1						
Assaulted by other, Opening	1	1									
Slipped, fell, stumbled, other, Handling other track material/supplies	1							1			
Exposure to fumes - inhalation, Reaching	1				1						
Struck by on-track equipment, Handling ties	1	1									
Electrical shock, other (explain in narrative), Servicing	1	1									
Slack action, draft, compressive buff/coupling, Inspecting	1							1			
Caught in/compressed by powered hand tools, Cutting vegetation	1	1									
Sustained viewing, Standing	1	1									
Exposure to fumes - inhalation, Cutting, other	1	1									
Electrical shock, other (explain in narrative), Replacing	1	1									
Burned, Adjusting coupler	1	1									
Needle puncture/prick/stick, Welding (includes field welding)	1	1									
Stepped on object, Maintaining	1					1					
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Getting out	1	1									
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Pulling pin lifter/operating uncoupling	1	1									
Sudden/unexpected movement of on-track equipment, Loading/unloading	1	1									
Horseplay, practical joke, etc., Laying	1		1								
Slipped,fell,stumbled,etc. on oil, grease,etc., Ascending	1	1									
Repetitive motion - other (describe in narrative), Lining switches	1	1									
Slipped,fell,stumbled etc. due to object,ballast, spike, etc., Standing	1	1									

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Slipped,fell,stumbled,etc. due to irregular surface, Handbrakes, releasing	1	1									
Blowing/falling debris, Handbrakes, releasing	1	1									
Caught Between Material, Pushing	1	1									
Aggravated pre-existing condition, Opening/closing angle cock	1	1									
Defective/malfunctioning equipment, Lifting equipment (tools, parts, etc.)	1	1									
Aggravated pre-existing condition, Descending	1				1						
Bitten/stung by bee, spider, other insect, Other (Narrative must be provided)	1	1									
Ran into object/equipment, Other (Narrative must be provided)	1	1									
Blowing/falling debris, Lining switches	1	1									
Caught in/compressed by hand tools, Adjusting, other	1	1									
Sudden, unexpected movement, other, Ascending	1				1						
Overexertion, Stepping over	1	1									
Sudden, unexpected movement, other, Coupling air hose	1	1									
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Riding	1	1									
Ran into object/equipment, Moving	1	1									
Sudden/unexpected movement of material, Servicing	1	1									
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Handling material, general	1	1									
Struck by thrown or propelled object, Flagging	1	1									
Struck by object, Washing	1	1									
Repetitive motion - tools, Cleaning	1	1									
Ran into object/equipment, Getting on	1						1				
Missed, handhold, grabiron, step, etc., Closing	1	1									
Sudden/unexpected movement of material, Lining switches	1	1									
Slipped,fell,stumbled,etc. on oil, grease,etc., Opening	1							1			
Defective/malfunctioning equipment, Other (Narrative must be provided)	1	1									
Aggravated pre-existing condition, Spiking (installation/removal)	1	1									
Lost balance, Opening/closing angle cock	1	1									
Exposure to poisonous plants, Pushing	1				1						
Needle puncture/prick/stick, Handling material, general	1	1									
Overexertion, Chaining, cabling car or locomotive	1	1									
Repetitive motion - typing, keyboard, etc., Operating	1	1									

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY
06:45 Wednesday, May 18, 2005

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Slipped,fell,stumbled,etc. on oil, grease,etc., Washing	1	1	.	.	.	.	.	.	.	.	.
Rubbed, abraded, etc., Walking	1	1	.	.	.	.	.	.	.	.	.
Overexertion, Applying rail anchor/fastener	1	1	.	.	.	.	.	.	.	.	.
Caught in/compressed by hand tools, Replacing	1	1	.	.	.	.	.	.	.	.	.
Assaulted by other, Inspecting	1	1	.	.	.	.	.	.	.	.	.
Repetitive motion - other (describe in narrative), Lifting equipment (tools, parts, etc.)	1	1	.	.	.	.	.	.	.	.	.
Other (describe in narrative), Cutting vegetation	1	1	.	.	.	.	.	.	.	.	.
Burned, Other (Narrative must be provided)	1	1	.	.	.	.	.	.	.	.	.
Defective/malfunctioning equipment, Digging, excavating	1	1	.	.	.	.	.	.	.	.	.
Stepped on object, Jumping onto	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Handling tie plates	1	1	.	.	.	.	.	.	.	.	.
Other impacts - on track equipment, Inspecting	1	1	.	.	.	.	.	.	.	.	.
Struck by object, Servicing	1	1	.	.	.	.	.	.	.	.	.
Bumped, Inspecting	1	1	.	.	.	.	.	.	.	.	.
Defective/malfunctioning equipment, Stepped on	1	1	.	.	.	.	.	.	.	.	.
Sudden, unexpected movement, other, Stepping up	1	1	.	.	.	.	.	.	.	.	.
Rubbed, abraded, etc., Bending, stooping	1	.	.	.	.	.	1	.	.	.	.
Slipped, fell, stumbled, other, Bending, stooping	1	1	.	.	.	.	.	.	.	.	.
Lost balance, Handling car parts	1	.	.	.	1	.	.	.	.	.	.
Aggravated pre-existing condition, Stepped on	1	1	.	.	.	.	.	.	.	.	.
Struck against object, Servicing	1	1	.	.	.	.	.	.	.	.	.
Sudden, unexpected movement, other, Welding (includes field welding)	1	1	.	.	.	.	.	.	.	.	.
Rubbed, abraded, etc., Carrying	1	1	.	.	.	.	.	.	.	.	.
Slipped,fell,stumbled,etc. due to object,ballast, spike, etc., Pulling	1	1	.	.	.	.	.	.	.	.	.
Other (describe in narrative), Handling locomotive parts	1	1	.	.	.	.	.	.	.	.	.
Repetitive motion - typing, keyboard, etc., Other (Narrative must be provided)	1	1	.	.	.	.	.	.	.	.	.
Struck by on-track equipment, Derail, removing	1	1	.	.	.	.	.	.	.	.	.
Climatic conditions, other (e.g., high winds), Opening	1	1	.	.	.	.	.	.	.	.	.
Electrical shock from hand tool, Inspecting	1	1	.	.	.	.	.	.	.	.	.
Aggravated pre-existing condition, Cutting vegetation	1	1	.	.	.	.	.	.	.	.	.
Missed handhold, grabiron, step, etc., Repairing	1	1	.	.	.	.	.	.	.	.	.
Cave in, slide, etc., Sitting	1	1	.	.	.	.	.	.	.	.	.
Burned, Inspecting	1	1	.	.	.	.	.	.	.	.	.
Slipped, fell, stumbled, other, Spiking (installation/removal)	1	1	.	.	.	.	.	.	.	.	.

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Struck by object, Getting in	1	1									
Sudden release of air, Uncoupling air hose	1	1									
Rubbed, abraded, etc., Cutting, other	1	1									
Caught in/compressed by other machinery, Standing	1	1									
Slipped fell stumbled etc. on oil, grease etc., Handling locomotive parts	1	1									
Repetitive motion - tools, Using, other	1	1									
Caught, crushed, pinched, other, Crossing between	1		1								
Caught in/compressed by other machinery, Adjusting, other	1	1									
Bitten/stung by bee, spider, other insect, Cleaning	1	1									
Slipped,fell,stumbled etc. on oil, grease,etc., Fueling	1	1									
Caught Between Equipment, Adjusting coupler	1	1									
Defective/malfunctioning equipment, Repairing	1	1									
Aggravated pre-existing condition, Washing	1						1				
On track equipment, other incidents, Lying down	1		1								
Rubbed, abraded, etc., Sitting	1			1							
Repetitive motion - work processes, Ascending	1	1									
Caught Between Equipment, Climbing over/on	1	1									
Climatic condition, exposure to environmental cold, Cleaning	1	1									
Caught in/crushed by materials, Cutting, other	1					1					
Repetitive motion - work processes, Handling baggage	1	1									
Pushed/shoved from, Stepping down	1				1						
Sudden, unexpected movement, other, Exercising	1	1									
Aggravated pre-existing condition, Handling material, general	1	1									
Sudden, unexpected movement, other, Handling ties	1	1									
Bodily function/sudden movement e.g.,sneezing,twisting, Uncoupling electric cables	1	1									
Caught in/crushed by materials, Pushing	1	1									
Blowing/falling debris, Lying down	1	1									
Slipped, fell, stumbled, etc. due to climatic condition, Servicing	1	1									
Burned, Repairing	1	1									
Struck by falling object, Climbing over/on	1	1									
Horseplay, practical joke, etc., Reaching	1	1									
Struck by on-track equipment, Lining switches	1	1									

(Continued)

CIRCUMSTANCES IN OTHER INCIDENTS FOR 2004, AND TYPE PERSON INVOLVED, BY DESCENDING FREQUENCY

	Total	Worker on duty - employee	Trespassers	Passenger on train	Nontrespasser on rr property	Contractor - other	Employee not on duty	Worker on duty - contractor	Nontrespasser off rr property	Worker on Duty - volunteer	Volunteer
Slipped fell stumbled,etc. on oil, grease,etc., Crossing between	1	1									
Other (describe in narrative), Washing	1	1									
Repetitive motion - tools, Grinding	1	1									
Caught, crushed, pinched, other, Washing	1	1									
Blowing/falling debris, Opening	1	1									
Blowing/falling debris, Handling material, general	1	1									
Repetitive motion - work processes, Loading/unloading	1	1									
Repetitive motion - work processes, Climbing over/on	1	1									
Sudden/unexpected movement of material, Lifting equipment (tools, parts, etc.)	1	1									
Slipped, fell, stumbled, etc. due to climatic condition, Handling material, general	1	1									
Electrical shock due to contact with 3rd rail, catenary, pantograph, Climbing over/on	1		1								
Caught in/compressed by other machinery, Ascending	1	1									
Caught, crushed, pinched, other, Laying	1							1			
Overexertion, Crossing over	1	1									
Struck by on-track equipment, Adjusting, other	1	1									
Electrical shock, other (explain in narrative), Handling, other	1	1									
Caught Between Equipment, Closing	1	1									
Sudden/Unexpected Movement of tools, Handbrakes, applying	1	1									
Struck by object, Coupling electric cables	1	1									
Aggravated pre-existing condition, Coupling air hose	1	1									
Climatic conditions, other (e.g., high winds), Inspecting	1	1									
Ran into object/equipment, Descending	1	1									
Caught in/compressed by other machinery, Pulling pin lifter/operating uncoupling	1	1									
Burned, Handling other track material/supplies	1	1									
Horseplay, practical joke, etc., Jumping onto	1		1								
Sudden, unexpected movement, other, Pulling pin lifter/operating uncoupling	1	1									
Total	7,756	5,391	878	518	419	197	188	144	16	3	2

Mr. MENENDEZ. Okay. Positive Train Control has been on the NTSB's list of Most Wanted Transportation Safety Improvements since 1990. Why did it take the FRA 15 years to issue a final rule on PTC?

Ms. STRANG. That is a very good question. And since I am not on the regulatory side of things, I cannot answer. But I can have somebody provide the answer to you for the record.

Mr. MENENDEZ. If you would, I would appreciate it.

[The information received follows:]

ANSWER: FRA, like the NTSB, strongly supports the concept and promise of PTC. In a 1994 report to Congress, FRA coined the term APositive Train Control@ to encompass positive train separation (collision avoidance), protection from overspeed operation, and protection of roadway workers. In that report, FRA described a range of actions that would be helpful to promote the introduction of this technology. On September 30, 1997, the new Railroad Safety Advisory Committee (RSAC) accepted three tasks from FRA, including examination of the possible mandating of PTC on a portion of the national rail system and preparation of a proposed rule to facilitate its introduction. In 1999, the RSAC presented a report to the Administrator that concluded that safety benefits were insufficient to support PTC investments, even on a corridor-by-corridor basis, but referred favorably to safety performance standards then under development.

The RSAC task to prepare rules to enable new technology was the first performance-based, consensus-based rulemaking undertaken by FRA and was extremely difficult. Despite the problems, a notice of proposed rulemaking was produced in 2001. The next two years were spent in consideration of all the many comments and concerns subsequently submitted. The remaining time--from late 2003 until March 2005, when the final rule was published in the Federal Register--primarily involved the process of review by the Office of the Secretary of Transportation and the Office of Management and Budget.

Throughout this entire time period, FRA has continually provided extensive support for no less than eight different PTC projects currently in various stages of implementation, the success of which is not in small part due to FRA assistance.

A final order requiring use of the Advanced Civil Speed Enforcement System was issued in 1998 in support of high-speed rail planning on the Northeast Corridor, and that system is now in place between New Haven and Boston and on short segments south of New York City where trains operate above 125 miles per hour. FRA has also provided waiver authority for the Incremental Train Control System, which supports operations to 90 mph on Amtrak=s line in Michigan. FRA has provided waiver authority for extensive testing of Aoverlay@ PTC systems on CSX Transportation, Inc., and BNSF Railway, and a test waiver is also in place for the Illinois DOT Project, which is part of the North American PTC Program.

Mr. MENENDEZ. Since you are not on the regulatory side, you are going to give me the same answer to one of my other questions, but I am going to ask it so that you get me an answer. You cite human factors as one of the causes at the very outset of your testimony. So I would also like to know when you have investigated 38 railroad accidents where PTC could have prevented or mitigated an accident, despite that it will save lives, the rule that you issued in March is voluntary and not a requisite for railroads. I would like to get an answer as to why the regulators did not insist on something that can be life-saving at the end of the day and dramatically reduce the number of incidents. So if you would get that for us as well.

Ms. STRANG. Yes, sir.

[The information received follows:]

ANSWER: FRA strongly supports the concept of PTC as a potential deterrent to railroad collisions. However, FRA is against mandating installation of PTC because, as we have previously reported to Congress, the safety benefits of PTC would not justify the substantial costs of forced installation.

Rail collisions and other events preventable by PTC technology constitute only about two percent of reportable train accidents in any given year. (The Graniteville, South Carolina, accident could have been prevented by a PTC system, but the accident could also have been prevented were the railroad to have had better operating rules. FRA has issued a safety advisory on switch safety guidelines that should help prevent future accidents involving improperly lined switches, and FRA has launched a regulatory initiative to address leading human factor causes of train accidents and is developing data on Aclose calls@ to reveal the reasons for human failures.)
The direct safety benefits of full implementation of PTC systems on all Class I railroads ($40 million to $56 million annually) are small relative to the costs of such systems (between $1.2 billion and $3.7 billion over six years), and do not support the issuance of a Federal rule mandating PTC systems.

FRA=s August 2004 report to Congress points out that potential net societal benefits of PTC systems are huge (between $762 million and $2.43 billion in the first year after complete installation of the PTC systems). However, most of these benefits would be reaped by shippers through reduced rates and by the rest of society (truck traffic diversion to the railroads that results in reduced highway accidents and reduced air pollution). The railroads= share of the net societal benefits would be between a net loss of $7.1 million and a gain of $202 million annually. It should be noted that these estimates are based on untested assumptions that have been questioned by the railroads; the estimates can only be verified through actual in-service experience with PTC.

FRA=s March 2005 final rule establishes performance standards for the development and use of processor based signal and train control systems, which will facilitate the use of PTC systems.

FRA will continue to support development of PTC through the Illinois Department of Transportation project and provide technical assistance for industry efforts to create more cost-effective technology.

Mr. MENENDEZ. Do you know about dark territory, is that something you can answer?

Ms. STRANG. I know what it is.

Mr. MENENDEZ. Okay. What can you answer for me?

Ms. STRANG. I can answer questions about technology.

Mr. MENENDEZ. Technology, okay. Let me move on to something else then.

Mr. Chipkevich, when an accident occurs it is critical that the community, the railroad industry, its workers, and in some cases the victims are provided timely and accurate information identifying what caused the accident and what measures parties involved in the accident should take to prevent similar accidents from occurring in the future. How long does it take the NTSB to conduct an accident investigation? And why did it take you over two years to investigate and issue recommendations on the deadly accident in North Dakota? Why did it take you over three years to investigate and issue recommendations on the CSX freight tunnel derailment and fire in the Howard Street tunnel?

Mr. CHIPKEVICH. It is primarily the workload and the staff resources that we have had to be able to address and do the accident investigations. There was significant work in the Howard Street tunnel accident investigation we did because there was no clear-cut cause that we could identify for that accident. So we did extensive testing and additional work that did take an extended period of time in that particular accident.

Mr. MENENDEZ. So, in other words, if you had a greater staffing capability, we would truncate the time and get the results quicker, and we would get action, hopefully, quicker on that?

Mr. CHIPKEVICH. Yes, sir, that would help.

Mr. MENENDEZ. How many hearings has the NTSB held since 2000, public hearings?

Mr. CHIPKEVICH. I can provide that for the record. We held a public hearing, we finished the last two days on the Macdona accident where we had a board of inquiry taking testimony from 12 witnesses. We had also had a public hearing in the rail area on the Minot accident investigation. But I would certainly be glad to provide that information.

[The information received follows:]

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NTSB
National Transportation Safety Board
490 L'Enfant Plaza, SW
Washington, DC 20594-0001
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JUN 01 2005

Honorable Robert Menendez
U.S. House of Representatives
2238 Rayburn House Office Building
Washington, D.C. 20515

Dear Representative Menendez:

On Thursday, April 28, 2005, the Committee on Transportation and Infrastructure, Subcommittee on Railroads, held a hearing on new technologies for rail safety and security. Mr. Robert Chipkevich, Director of the Office of Railroad, Pipeline and Hazardous Materials Investigations, of the National Transportation Safety Board (NTSB), was a witness at that hearing.

Upon the conclusion of his testimony, Mr. Chipkevich was asked to respond to a question regarding the number of public hearings held at the Safety Board for the past five years for the record. Enclosed for your information is a copy of all public hearings held by the NTSB from 2000-2005. A public hearing has also been scheduled for June 13-15, 2005, regarding Pinnacle Airlines flight 3701, which occurred near Jefferson City, Missouri on October 14, 2004. Also enclosed for your information is a copy of the Safety Board's purpose and procedure on conducting a public hearing.

I hope this information responds to your question and, if you have any additional questions or concerns, please do not hesitate to contact me.

Sincerely,

Mark V. Rosenker
Acting Chairman

Enclosures

cc Glenn Scammel, Staff Director
Tracy Mosebey, Clerk

News & Events

PUBLIC HEARINGS

As part of its investigation into certain accidents, the Safety Board may hold a public hearing to record evidence presented by persons involved in the accident and by parties to the investigation. See the detailed description for general information. The public and the media are welcome to attend the hearing and listen to the proceedings, or they can view a webcast of the hearing. See Previous Hearings for on-line access to exhibit items and other detailed information from those dates.

Policy on Photographing, Video, and Audio Recording of NTSB Proceedings

Media Contact: NTSB Public Affairs Office, (202) 314-6100.

Upcoming Hearings

Date/Time/Location	Topic(s)	More Information
TBA	TBA	Webcast Information

Previous Hearings

Date	Topic	More Information
April 26-27, 2005	Collision between Union Pacific Railroad (UP) and Burlington Northern Santa Fe (BNSF), Macdona, Texas, June 28, 2004. Webcast Archive: *(Webcast Technical Support)* Day 1 - April 26, 2005: Real Video | Windows Media Day 2 - April 27, 2005: Real Video | Windows Media	Details
July 27-28, 2004	Aviation Image Recording	Details
May 20-21, 2003	Crash of Air Midwest Flight 5481	Details
March 18-19, 2003	Medical Oversight of Non-Commercial Drivers	Details
Oct 29- Nov 1, 2002	Crash of American Airlines Flight 587 November 12, 2001 Belle Harbor, NY	Details Press Release
July 15-16, 2002	Minot, North Dakota	Press Release

	Derailment Canadian Pacific Railway January 18, 2002	
May 9, 2002	Emery Worldwide Airlines Flight 17 near Rancho Cordova, Ca. February 16, 2000	Press Release Preliminary Report
December 13-15, 2000	Alaska Airlines Flight 261 near Port Hueneme, California January 31, 2000	Details Press Release
November 15-16, 2000	Pipeline Safety Hearing	Details
January 26-29, 2000	American Airlines Flight 1420 Little Rock, Arkansas June 1, 1999	Details Media Advisory Press Release SB99-35
January 20-21, 2000	Effectiveness of Commercial Driver Oversight Programs	Details

About the NTSB

PUBLIC HEARINGS [Schedule]

PURPOSE

The National Transportation Safety Board conducts public hearings for the purpose of supplementing the facts discovered during the on-scene and subsequent follow-up investigation of the accident. Public hearings generally are held with regard to a major accident in which there is wide and sustained public interest, or significant safety issues. Testimony is obtained through public hearings to ensure an accurate, complete and well-documented factual record.

The Safety Board is a public agency, and conducts its investigations in a public manner. A public hearing enables the Safety Board to meet its mandate to conduct in-depth objective accident investigations, without bias or undue influence from industry or other government agencies. It is an exercise in accountability: accountability that the Safety Board is conducting a thorough and fair investigation and accountability on the part of industry and other government agencies that they are fulfilling their responsibilities.

The Safety Board does not determine the rights or liability of the parties involved in the accident. Therefore, matters dealing with such rights or liability are excluded from the hearing proceedings. Instead, the hearing is intended to collect information that will assist the Safety Board in its examination of the safety issues arising from the accident.

PARTICIPANTS

A hearing involves Safety Board investigators, other parties to the investigation, and expert witnesses called to testify.

At each hearing, a Board of Inquiry is established that is made up of senior Safety Board staff, chaired by the presiding Board Member.

The Board of Inquiry is assisted by a Technical Panel. Some of the Safety Board investigators that have participated in the investigation serve on the Technical Panel. Depending on the topics to be addressed at the hearing, the panel often includes specialists in the areas of aircraft performance, powerplants, systems, structures, operations, air traffic control, weather, survival factors, and human factors. Those involved in reading out the cockpit voice recorder and flight data recorder, and in reviewing witness and maintenance records also might participate in the hearing.

Parties to the hearing are designated by the Safety Board Member who is the presiding officer of the hearing. They include those persons, governmental agencies, companies, and associations whose participation in the hearing is deemed necessary in the public interest and whose special knowledge will contribute to the development of pertinent evidence are designated as parties. Typically, they include the Federal Aviation Administration, operator, airframe manufacturer, engine manufacturer, pilots union, and any other organization that can assist the Safety Board in completing its record of the investigation. Except for the FAA, party status is a privilege, not a right. Parties are asked to appoint a single spokesperson for the hearing.

Expert witnesses are called to testify under oath on selected topics to assist the Safety Board in its investigation. The testimony is intended to expand the public record and to demonstrate to the public that a complete, open and objective investigation is being conducted. The witnesses who are called to testify have been selected because of their ability to provide the best available information on the issues related to the accident.

News media, family members, lawyers, and insurance personnel are not parties to the investigation, and are not permited to participate in the public hearings.

PROCEDURE

The decision as to whether a public hearing will be held is made by the Safety Board. Hearings are generally scheduled a sufficient period of time after the accident to allow for documentation and preliminary evaluation of all factual data, preliminary exploration of the issues, conduct of necessary tests, and the preparation or gathering of necessary exhibits.

Prior to the hearing, a prehearing conference is held. It is attended by the Safety Board's Technical Panel and representatives of the parties to the hearing. During that conference, the areas of inquiry and the scope of the issues to be explored at the hearing are delineated and the selection of the witnesses to testify to these issues is finalized.

The witnesses are questioned first by the Board's Technical Panel, then by the designated spokesperson for each party to the hearing and finally by the Board of Inquiry.

The Chairman of the Board of Inquiry is responsible for the conduct of the hearing. The Chairman makes all rulings on the admissibility of evidence, and all such rulings are final.

PRODUCT

The record of the investigation including the transcript of the hearing and all exhibits entered into the record will become part of the Safety Board's public docket on the accident.

Following the hearing, investigators will gather additional needed information and conduct further tests identified as necessary during the hearing. After the investigation is complete and all parties have had an opportunity to review the factual record, both from the hearing and other investigative activities, a technical review meeting of all parties is convened. That meeting is held to ensure that no errors exist in the investigation, and that there is agreement that all that is necessary has been done.

On rare occasions, the hearing may be reopened when significant new additional information becomes available, or follow-up investigation reveals additional issues that call for an airing in a public forum such as a hearing. This was most recently done in the Safety Board's investigation of the September 8, 1994 accident involving USAir flight 427 at Aliquippa, Pennsylvania, near Pittsburgh.

After the hearing and fact finding portion of the investigation are completed, the Safety Board staff completes its analysis of the facts. Parties do not participate in the Safety Board analysis, although they are encouraged to submit findings, recommendations and probable cause statements that they believe the Safety Board should conclude from the record. The final report of the investigation is completed by the Safety Board staff and forwarded to the Safety Board for its deliberation and adoption.

The final report is discussed and adopted by Board Members at a public meeting held in Washington,

D.C. Non-Safety Board personnel, including parties, cannot interact with the Board during that meeting. Copies of the final report, containing the findings, probable cause, and safety recommendations are provided to families, the public and the parties.

NTSB Home Page | About the NTSB | Hearing Schedule

Mr. MENENDEZ. My information is it is only one. Now you have had some things called symposiums, but those are not public hearings. I would like to know the number so that we can respond to it in the future.

Thank you, Mr. Chairman.

Mr. LATOURETTE. I thank the gentleman. Mr. Miller?

Mr. MILLER. Thank you, Mr. Chairman.

Ms. Strang, where does the FRA stand on the use of control coaches after the recent fatal crash of Metrolink? Would it not be safer to use a locomotive on the front of the train? I understand that Amtrak has even converted some old locomotives into control cars. They removed the diesel motor and use the space to basically carry baggage. A working locomotive is placed at the other end of the train to power it. Is this not a safer setup than lightweight control cars?

Ms. STRANG. That is a good question. Actually, we are conducting a study on that now. There is some debate over the Glendale incident, whether or not it could have been made worse by a locomotive because they are heavier and it adds mass to the crash. Those are all things that we are considering carefully, and we should be publishing a study by the end of the year.

Mr. MILLER. Okay. Can you give us some more details concerning what the FRA is doing on tank car safety.

Ms. STRANG. Actually, we have several things we are doing on tank car safety. One of them deals with emergency responders and making sure that they get emergency response information as quickly as possible. We are working through the emergency responder community, Railinc Operation Respond, and others to provide better communications infrastructure to get information to emergency responders that is accurate as quickly as we can, because the first several minutes of the emergency response are very critical.

We are looking at tank car research that I talked about on the kinematics modeling, where we will be looking at tank car design to make tank cars more puncture-resistant and less likely to have any kind of failure during a collision or derailment.

We are also looking at a spray-on coating that is known as "Dragon Shield" that has got the capability of self-sealing if it gets punctured, and it also adds impact resistance.

Mr. MILLER. They have recently included tables in passenger cars. I know you did a study on that. I have heard that really is dangerous and that it creates a less safe situation. What is your finding on that?

Ms. STRANG. It can be. The way that the table is fastened to the floor and the edges of the table, and whether or not they are resistant or flexible, really make a difference. So we have done tests on table configurations and expect to have standards and recommendations on how tables should be affixed. Tables are very popular with commuters. They like them a lot. So most commuter railroads like to have them.

Mr. MILLER. When are your studies going to be released, do you have any idea on that?

Ms. STRANG. We have conducted the tests on the tables, and I believe a report will be coming out later this year. But I can get back to you with the expected date.

[The information received follows:]

ANSWER: I am informed that some of the new studies on the safety of tables in passenger cars have already been released. I wish to submit for the record a copy of a recent summary of the results of these studies and estimates of when the additional studies will be completed. I also wish to submit for the record a copy of the two most recent studies that are not yet posted on the Volpe National Transportation Systems Center Web site. [Insert FRA Exhibits 3-5.]

Summary of crashworthiness research on tables in passenger cars.

Tables were studied as part of the research conducted in support of developing the crashworthiness specifications for Amtrak's high speed trainset. The results of these studies are documented in [1, 2, 3]. As a result of these studies, specifications for table attachment strength were included in the high speed trainset specification.

Commuter seats with intervening tables were dynamically sled tested. The results of these sled tests are documented in [4]. The results of these sled tests showed that typical commuter tables could fail under impact conditions. Also, the computer models were refined using the test results.

Two fatalities occurred when a freight train collided with a standing passenger train in Placentia, California on April 23, 2002. The refined computer models were used to help determine the likely sequence of events that led to these fatalities; this analysis is documented in [5].

Commuter seats with intervening tables were included as part of the fullscale impact test of two coupled passenger cars with crush zones. These experiments included experimental test dummies to measure the abdominal load. (The earlier sled tests used conventional test dummies, which cannot measure abdominal load. The fatalities in the Placentia accident were principally due to injuries sustained owing to high abdominal loads.) The results of these occupant protection experiments are documented in [6]. These experiments confirmed the analysis results described in [5].

Currently an improved occupant-protection table design is being developed. An overview of the methodology being used to develop the design is presented in [7]. The design is to be completed by this September, and test articles are to be constructed by this December. These test articles will be used in the train-to-train impact test of passenger equipment with crush zones, which is planned for February 2006. An overview of this test is presented in [8].

Papers and reports are planned on the final design for the improved workstation table and on the results of the fullscale test. A paper on the design will be presented this November at Winter Annual Meeting of the American Society of Mechanical Engineers (ASME). A paper on test results is planned for the ASME/Institute of Electrical and Electronics Engineers Joint Railroad Conference in March 2006. A final report on the table design is planned for November 2007, and final report on the occupant experiments conducted as part of the train-to-train test is planned for February 2008.

References

[1] Tyrell, D.C., Severson, K.J., Marquis, B.J., "Evaluation of Selected Crashworthiness Strategies for Passenger Trains," Transportation Research Record No. 1489, pp. 50-58, National Academy Press, 1995.

[2] Tyrell, D.C., Severson, K.J., Marquis, B.J., "Analysis of Occupant Protection Strategies in Train Collisions," American Society of Mechanical Engineers, AMD-Vol. 210, BED-Vol. 30, pp. 539-557, 1995.

[3] Tyrell, D.C., Severson, K.J., Marquis, B.J., "Crashworthiness of Passenger Trains," US Department of Transportation, DOT/FRA/ORD-97/10, 1998.

[4] VanIngen-Dunn, C., "Commuter Rail Seat Testing and Analysis of Facing Seats," US Department of Transportation, DOT/FRA/ORD-03/06, December 2003.

[5] Parent, D., Tyrell, D., Perlman, A.B., "Crashworthiness Analysis of the Placentia, CA Rail Collision," Proceedings of ICrash 2004, International Crashworthiness Conference, San Francisco, California, July 14-16, 2004.

[6] Severson, K., Parent, D., Tyrell, D., "Two-Car Impact Test of Crash Energy Management Passenger Rail Cars: Analysis of Occupant Protection Measurements," American Society of Mechanical Engineers, Paper No. IMECE2004-61249, November 2004.

[7] Parent, D., Tyrell, D., Perlman, A.B., Matthews, "Evaluating Abdominal Injury in Workstation Table Impacts," Compendium of Papers, 84th Annual Meeting, Transportation Research Board, January 9-13, 2005.

[8] Tyrell, D., Jacobsen, K., Parent, D., Perlman, A.B., "Preparations for a Train-to-Train Impact Test of Crash-Energy Management Passenger Rail Equipment," American Society of Mechanical Engineers, Paper No. IMECE2005-70045, March 2005.

Note: All of the references except [7] and [8] can be found at:

http://www.volpe.dot.gov/sdd/pubs-crash.html

Proceedings of JRC2005
2005 Joint Rail Conference
March 16-18, 2005, Pueblo, Colorado

RTD2005-70045

Preparations for a Train-to-Train Impact Test of Crash-Energy Management Passenger Rail Equipment

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ABSTRACT

Preparations are ongoing for a full-scale train-to-train impact test of crash-energy management (CEM) equipment, during which a cab car-led passenger consist, initially moving at 30 mph, will impact a standing locomotive-led consist. The colliding consists will be of approximately equal masses. This test is planned for November 2005.

The purpose of the full-scale testing program is to define the crashworthiness performance of conventional and CEM passenger equipment. In the train-to-train test of conventional equipment, the lead cab car crushed by nearly 22 feet and overrode the standing locomotive. In the train-to-train test of CEM equipment, the leading end of the impacting cab car is expected to crush by approximately 3 feet and distribute crush to the successive car interfaces. The consist is expected to remain in-line, with no lateral buckling and override modes of deformation.

This paper describes the steps being taken to develop a CEM cab car crush zone design, based upon the recently developed and tested coach car crush zone design. The components required for an effective CEM cab car design include a push-back coupler, energy absorbing elements, a crushable anti-climber to manage the interaction with the locomotive, and a cage for preserving the operator's space. Preliminary predictions of the dynamic response of the two consists include the distribution of crush among the cars in the train and the decelerations of the cars. These predictions are compared with the measurements made during the conventional train-to-train test.

While the CEM design preserves occupant volume, the secondary impact velocities in the lead cab car and the first coach car may be more severe. Five occupant experiments will be included on the cab car and first coach car of the full-scale train-to-train impact test to ensure that the occupants are protected during the collision. These occupant experiments will include modified versions of forward-facing intercity seats, forward- and rear-facing commuter seats, and facing commuter seats with intervening workstation tables.

INTRODUCTION

The Federal Railroad Administration (FRA) has been conducting full-scale impact tests of passenger rail equipment. These tests have been organized around two collision scenarios: an in-line train-to-train collision and a grade crossing collision. The principal objective of these tests is to compare the performance of conventional and improved-crashworthiness design equipment under similar impact conditions.

Seven of eight initially planned tests have been conducted; the eighth is the train-to-train test of crash-energy management (CEM) equipment and planned for late 2005. In this test, a cab car led consist will collide with a locomotive-led consist at 30 mph. These test conditions are based on several train-to-train collisions, including the Prides Crossing, MA collision [1]. In the Prides Crossing collision, a commuter train traveling about 36 mph impacted an oncoming freight train traveling about 12 mph. The test conditions are also similar to the Placentia, CA collision [2], where the commuter train was standing and the freight train was traveling approximately 22 mph.

In a train-to-train test of conventional equipment, conducted on January 31, 2002, the cab car crushed by approximately 22 feet and overrode the impacting locomotive, eliminating the survival space for approximately 47 occupants [3]. The cab car in this test overrode the locomotive in a similar manner as the cab car overrode the locomotive in the Prides Crossing collision [1]. The conventional test results established a baseline crashworthiness measure of passenger rail equipment currently in use.

The passenger equipment to be used in the upcoming test is designed to preserve the space for the operator and passengers by dispersing the structural crush into unoccupied areas of the train. The cab car is expected to crush by approximately 3 feet at the impacted end and by 2 feet at the back end of the car. Altogether, 14 feet of structural crush is predicted to occur, but this crush is distributed among all the cars of the train.

Other tests based on the in-line train-to-train collision scenario include single car tests of conventional and CEM equipment, in which a single car impacted a fixed wall at 35 mph [4, 5]. In the single car test of conventional equipment, the car crushed by approximately 6 feet and the wheels of the lead truck lifted off the rails by 9 inches as it crushed. In contrast, the CEM car crushed by 3 feet and all the wheels remained on the track. In two-car tests of conventional and CEM equipment, two coupled cars impacted a fixed barrier at approximately 28 mph [6, 7]. The responses of the impacting car were similar to the single-car tests – the conventional car crushed by about 6 feet and rose vertically about 9 inches, while the CEM car crushed about 3 feet and its wheels remained on the rails. In the two car test of conventional equipment, the coupled cars sawtooth-buckled, and the trucks immediately adjacent to the coupled connection derailed. In the two car test of CEM equipment, the cars remained in-line, and none of the trucks derailed. These tests demonstrate that CEM equipment can successfully distribute the crush to unoccupied areas of multiple CEM vehicles and minimize both the lateral and vertical motions of the cars.

Two tests based on a grade-crossing collision scenario have also been conducted [8]. In these tests, the corner post of a cab car impacted a steel coil supported by a frangible wooden table, with the car initially traveling at 14 mph. One design tested was typical of cab car end frame designs developed in the 1990's, while the second design was compliant with rail passenger equipment regulations and standards promulgated in 1999 [9]. In the test of the 1990's design, the corner post failed and the operator's survival space was eliminated. In the test of the State-of-the-Art design, the corner post remained attached and the operator's survival space was preserved.

TEST DESCRIPTION

Figure 1 shows a schematic of the train-to-train impact test. In this test, a moving cab car led train impacts a standing locomotive-led train. The locomotive-led train includes two hopper cars, ballasted such that both trains weigh nearly the same. The impact locomotive is an EMD F40 compliant with the AAR S580 standard [10]. The cab car led train includes four coach cars and a trailing locomotive. The passenger car consist is typical of a commuter push-pull consist with a locomotive at one end, leading into a city and a cab car at the other to lead away from the city. The impact occurs on tangent track, with the cab car led train initially traveling at 30 mph.

A CEM end structure will be installed on each end of each passenger car. The interfaces contacting a locomotive (front end of the lead cab car and the rear end of the coach car adjacent to the rear of the locomotive) will have a cab car end frame that includes features such as a deformable anti-climber, pushback operator's cage and crushable components (similar to the CEM coach car design). The cab car CEM equipment is currently in the design process. The coach car crush zone design tested in the single- and two-car tests of CEM equipment is being adapted to a Budd M1 passenger car, and will be installed on three cars. The two Pioneer cars used in the single- and two-car tests of CEM equipment are currently being repaired for use in the train-to-train test.

Simulations of the test are currently being conducted in order to verify that the CEM design will function as intended and to determine the size and placement requirements for the structural instrumentation. These simulations are intended to assure that the final crush-zone designs limit the potential for override of the colliding equipment, and propagate the crush among all the cars of the train. Instrumentation will include accelerometers on all the cars, displacement transducers on the car suspensions and on the crush zones, strain gages at selected locations, and high- and conventional-speed cameras.

Occupant experiments will be included as part of the train-to-train test of CEM equipment. The interior configurations to be tested include facing seats with an intermediate table, forward-facing commuter seats, and rear-facing commuter seats. All of the interior configurations to be tested include features to increase occupant protection over conventional designs.

CAB CAR DESIGN DEVELOPMENT

The objectives of the cab car crush zone are three-fold: preserve the operator space, preserve the passenger space, and manage the collision for a range of geometries of the colliding equipment. Therefore, the crush-zone design in the cab car must fulfill more design requirements than the coach car. To achieve these goals, the cab car design relies on concepts developed in the coach car crush zone design [11] and a study of effective anti-climbers [12].

The basic concept of crash-energy management is that the end structure crushes in a controlled manner during an impact. Additional features of the cab car include a crushable anti-climber that conforms to the geometry of the colliding equipment and spreads the load across an integrated end frame that can pushback during a collision and preserve the operator space. This crush zone is capable of absorbing at least 2.5 million foot-pounds of energy, and can function as a coach car crush zone. This design also meets all of the current FRA regulations and APTA standards for cab car crashworthiness, including the 800 kip buff load requirement, as well as all of the collision and corner post requirements. A car with this end structure remains within the geometric limits for traversing a curve coupled to another car and can couple with conventional rail passenger equipment.

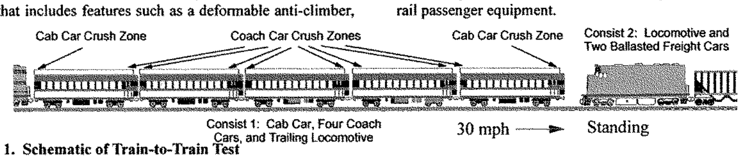

Figure 1. Schematic of Train-to-Train Test

Figure 2 shows a schematic of the cab car crush zone conceptual design. This concept includes four key elements:

1. A deformable anti-climber arrangement
2. A push-back coupler mechanism
3. An integrated end frame, which incorporates an operator volume
4. Roof and primary energy absorbing elements

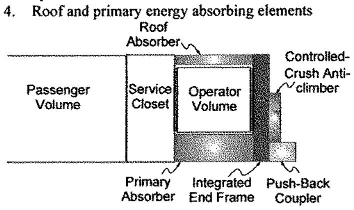

Figure 2. Cab Car Crush Zone Conceptual Design (Side View)

The activation of the push-back coupler initiates the crush zone and provides a mechanism that allows each component to operate in sequence. When the coupler triggers and pushes back, an energy absorbing element crushes. The travel of the shear-back mechanism accommodates the coupler of the impacting equipment to the extent necessary for the anti-climber and integrated end frame to engage the impacting equipment appropriately.

As the anti-climber begins to deform it incorporates the geometry of the locomotive and distributes the load over as large an area on the integrated end frame as can be reasonably achieved. As a goal, the collision posts should carry 60% of the crushable anti-climber loads and the corner posts 40%. The anti-climber is designed to crush in a controlled manner and must avoid forming a ramp or a catapult by limiting the potential for material failure. The anti-climber must sustain off-center impact loads and be able to transmit longitudinal loads into the end frame.

The integrated end frame is designed to remain sufficiently stiff in transmitting the impact load to the energy absorbers to assure the proper functioning of these elements. The integrated end frame can appropriately trigger and allow crushing of the energy absorbers when the coupler and the anti-climber share the impact load, or when the load path is through only the coupler or the crushable anti-climber. The structure attached for assuring survival volume of the operator can be pushed straight back into space normally taken by electrical and/or brake service closets. The expected structural deformation does not interfere with ready egress from the operator's compartment before and after the design crush zone stroke has been exhausted. The structure allows for the operator's seat to be attached with sufficient security to remain attached during the test. (Means of protecting the operator from the expected decelerations are currently being explored, including the use of inflatable structures [13].)

When the integrated end-frame is subject to a high-energy impact load, the cab car crush zone deforms in a controlled manner, activating both the roof and primary energy absorbers. The energy absorbers are able to properly function while accommodating the deflections of the integrated end frame. These devices can absorb more than 2 million foot-pounds of energy.

A conventional carbody structure, between the two body bolsters (i.e., the underfloor structures at each end of the car that provide support for the suspension), is sufficient to support the loads from the cab car crush zone as it crushes over its design stroke. The cab car crush zone design is being developed for retrofit onto an existing M1 car.

Figure 3 shows the preliminary force/crush characteristic for the cab car crush zone conceptual design. This force/crush characteristic is fundamentally similar to the one for the coach car crush zone design, with some differences. In order to accommodate impacts with equipment that have conventional couplers, the stroke of the push-back coupler (PBC) absorber is longer. A crushable anti-climber (AC) is required to accommodate a range of potential impacting equipment, locomotives, as well as other cab cars of various designs. The primary and roof energy absorbers are essentially the same as previously developed for the coach car crush zone.

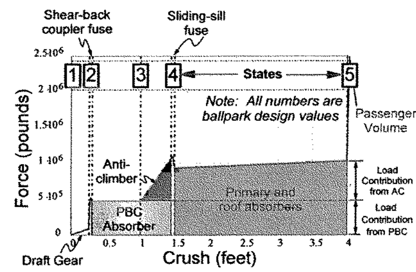

Figure 3. Preliminary Force/Crush Characteristic for Cab Car Crush Zone Conceptual Design

Figure 4 illustrates the desired kinematics of the cab car crush zone conceptual design during an impact with a conventional locomotive. Initially the couplers meet, in state 1. The stroke of the draft gear is eventually exhausted; the load increases on the structural fuse, which then releases in state 2. In state 3, the anti-climber is also engaged, and the load is shared between the anti-climber and the coupler. When the combined load on the coupler and anti-climber is sufficient, the energy absorber structural fuse releases in state 4. The primary and roof absorbers crush and reach state 5 when their stroke is exhausted.

The cab car crush zone is being designed to function for a range of initial conditions. It is designed to function for lateral and vertical misalignments of the colliding bodies of up to 3 inches, pitch and yaw of the cab car body of up to 0.4 degrees and pitch and yaw of the colliding locomotive of up to 0.5 degrees. These limits correspond to an end-to-end difference in elevation of approximately 6 inches for both the cab car and the locomotive.

Development of the design has progressed to the point where its interaction with an impacting locomotive can be simulated. The colliding equipment simulation techniques used to evaluate the conventional train-to-train test [14] are being applied to assure the functioning of the cab car crush zone under the full range of potential test conditions. The modeling will allow further refinement of the design. Once a design has been developed with satisfactory performance, detailed drawings will be generated, components will be built, and will be retrofitted onto an existing M1 passenger car.

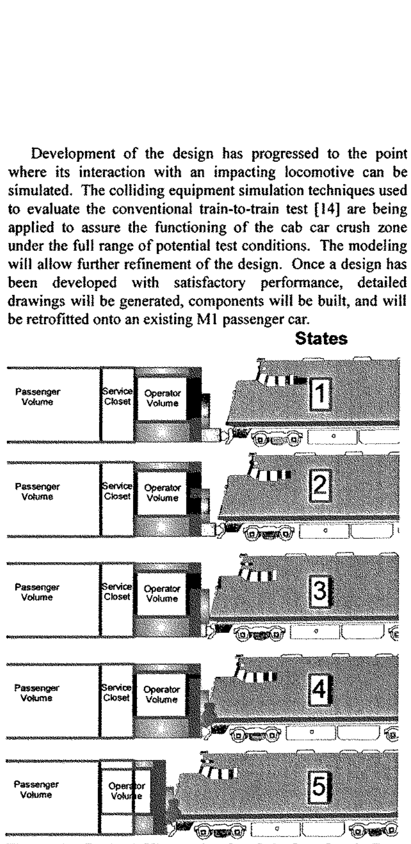

Figure 4. Desired Kinematics for Cab Car Crush Zone Conceptual Design

EQUIPMENT DESIGN AND CONSTRUCTION

Two cab cars and three coach cars are being modified with crush zones for the train-to-train test of CEM equipment. The Pioneer coach cars tested in the single-car [5] and two-car test [7] of CEM equipment have been repaired. The previously tested coach car crush zone design has been adapted to the M1 car. Coach car crush zones are being retrofitted to both ends of one M1 car. Two additional M1 cars will have a cab car crush zone on one end and a coach car crush zone on the other end.

Pioneer Coach Cars

Figure 5 is an illustration from the finite-element crush model of the Pioneer coach car crush zone, showing the principal components. Shear bolts act as a structural fuse, and keep the buff lug in place until a load of approximately 500 kips is reached. Once these bolts shear, the buff lug is pushed back by the coupler, crushing aluminum honeycomb. After the coupler has been pushed back, the end frame provides an additional load path. The sliding sill pushes back into the fixed sill when the combined load into the coupler and end beam reach the load required to trigger the structural fuse for the primary and roof energy absorbers. Shear bolts connect the sliding sill to the fixed sill and shear rivets connect the inner tube to the outer tube of the roof absorbers and act as structural fuses; the trigger load is approximately 1.2 million pounds. The details of this design are described further in the reference [11].

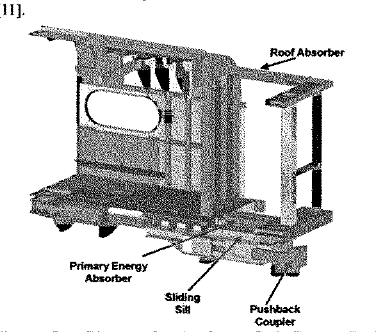

Figure 5. Pioneer Coach Cars, End Frame Design Schematic

Figure 6 shows the two Pioneer coach cars shortly before the two-car impact test. Major components – the end frame, sliding sill, fixed sill - were fabricated and shipped to TTC in Pueblo, CO. These components were installed by TTCI, who also cut and prepared the cars and fabricated the smaller components. After the single-car and two-car test, all of the energy absorbing elements – the primary, roof, and pushback coupler – had received at least some crush. New primary energy absorbers were fabricated and installed. New aluminum honeycomb in the pushback couplers and the roof absorbers, and new shear bolts and rivets were also installed. The repair of these crush zones has been completed.

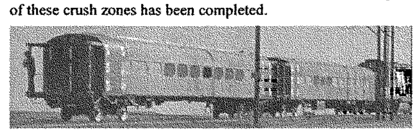

Figure 6. Pioneer Coach Cars, Shortly Before Two-Car Impact Test

M1 Coach Car

The original Pioneer and M1 cars were both designed and built by the Budd Company. The designs of these cars share many similarities, but there are also distinct differences. The center sills of both cars are identical, and the side sills are very similar – the side sills have nearly the same area and area-moment properties, but different shapes. The body bolsters are

different. The principal lateral members of the Pioneer body bolster have a shallow V shape, and attach to the bottom of the draft and center sills. The lateral members of the M1 body bolster are flat, and effectively pass through the draft and center sills.

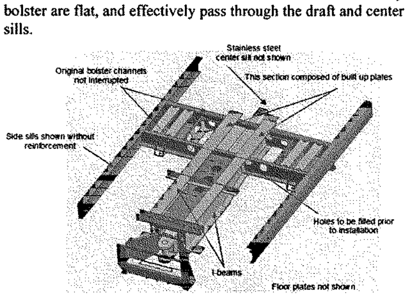

Figure 7. Crush-zone Draft Sill Integration with M1 Car Body Bolster and Center Sill

The most challenging aspect of adapting the Pioneer coach car crush zone has been the integration of the fixed (draft) sill with the body bolster of the M1 car. Figure 7 shows a drawing from a CAD model of the fixed/sliding sill and the M1 body bolster. Placement of the roof absorbers has also been altered for the M1 car. The drawing does not show the placement of the primary energy absorbers. The body bolster will be further reinforced than is shown in the figure, and the supports and energy absorbers will be added. The side sills outboard of the body bolster will be selectively reinforced to help support the primary energy absorbers. The side sills and center sills inboard of the body bolsters will not be altered.

The cross-sectional geometry of the M1 carbody is different from the Pioneer carbody. The shape of the M1 has allowed the rectangular cross-section roof absorbers to be squarely placed, while they were canted at approximately 45° angle in the Pioneer cars. More of the original roof will be retained in the M1 cars than was retained in the Pioneer cars, owing to the differences in carbody cross-section and the somewhat less restricted placement of the roof absorbers in the M1 cars.

The cars are currently being prepared for integration of the crush zones. The coach car crush zone will be retrofitted to two ends of one car and to one end of two cars (see Figure 1). TTCI is currently cutting the original ends from these cars, and preparing them for the installation of the crush-zone components. Drawings are being finalized, and parts are expected to ship from Ebenezer by the time of the 2005 ASME/IEEE Joint Rail Conference.

M1 Cab Cars

Figure 8 shows a CAD drawing of the current iteration of the cab car crush zone design. Principal differences with the coach car crush zone include the addition of the crushable anti-climber and the operator survival volume. The anti-climber is comprised of short rectangular tubes that support a stiff plate. This arrangement is intended to spread the load from an impacting vehicle into both the collision and corner posts. The operator's survival volume is intended to push back into the electrical and brake service closets. Additional differences include a longer push-back coupler stroke, to accommodate an impact with equipment which does not have a push-back coupler, and a center lug on the anti-telescoping plate, to engage the short hood of an impacting locomotive.

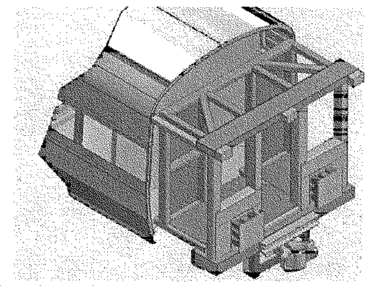

Figure 8. M1 Cab Car Crush Zone Draft Design

The electrical and brake service closets in cab cars are arranged to allow repair personnel access to the equipment inside. Figure 9 shows photographs of these service closets in an MBTA cab car manufactured by Kawasaki. The electrical closet is directly behind the operator's cab. The brake closet is behind the electrical closet. It is assumed that the brake closet could be located across the aisle from the electrical closet in a new car design.

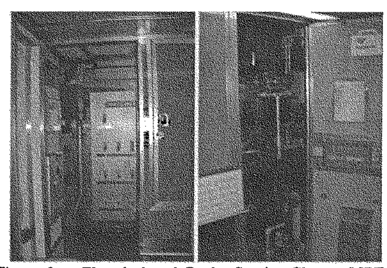

Figure 9. Electrical and Brake Service Closets, MBTA Commuter Car, built by Kawasaki

Impacts of the cab car with an F-40 locomotive are currently being simulated with a detailed finite-element model in order to refine the cab car crush zone design. These analyses are being used to help guide the selection of material, as well as to finalize the details of the geometry. Once key details of the design have been resolved, then design drawings will be made. Like the coach car crush zone design, the major components

will be constructed from the design drawings, and then installed by TTCI, who will also use a set of integration drawings to guide retrofit of the cars. Two cab car crush zones will be retrofitted onto two M1 cars. These cars will have coach car crush zones on the opposite ends.

STRUCTURAL TEST REQUIREMENTS

One-dimensional and three-dimensional collision dynamics models are currently being used to simulate the test, in order to estimate the crush distribution and the gross motions of each of the cars in the two trains. The current estimate of the cab car force-crush characteristic (see Figure 3) was used for the two crush zones contacting locomotive ends (see Figure 1) and the force-crush characteristic developed and measured for the CEM coach cars [7] was used as the crush behavior for all other passenger car ends. These simulations are being conducted in order to help range and locate the instrumentation to be used during the test.

CRUSH COMPARISON

Figure 10 shows the distribution of crush among the cars in the CEM consist. The amount of crush sustained by an individual car end and the total amount of damaged occupant volume in each passenger car is summed in each bar.

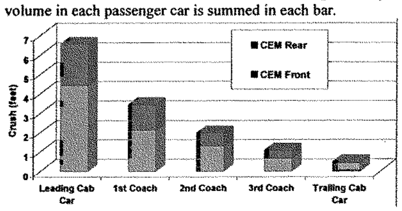

Figure 10. Crush Distributions

In the train-to-train test of conventional equipment, the impacted end of the leading cab car crushed by approximately 22 feet and the impact end of the leading locomotive sustained minor structural damage. There was no other structural damage observed in this test. The cab car overrode the locomotive during the test, in spite of the underframe of the cab car being substantially lower than the underframe of the locomotive. The force-crush characteristic of conventional passenger cars prevents the distribution of crush to successive cars. After a single high peak load is exceeded (structurally corresponding to the fracture of the draft sill), the car continues to crush at a relatively low uniform load.

The crush distribution plot in Figure 10 shows how the crush will be shared between the crush zones of the CEM consist. At the 30 mph impact speed, the crush zone of the lead cab car is nearly exhausted; crush is passed back to the following crush zones. Each car in the CEM system is characterized by an increasing, stepped force-crush behavior. When the force level on the first crush zone reaches the second step, and the primary energy absorbers crush, force levels also begin to be passed to the successive cars causing those crush zones to trigger. Because the pushback couplers trigger at a lower load than the primary energy absorbers, crush is distributed to additional crush zones before the third peak load level is exceeded at the lead crush zone.

The CEM crush behavior in this collision scenario indicates that energy absorption will be shared by multiple crush zones, consequently preventing damage to the occupied areas of the cars. An initial kinetic energy of 19.3 million ft-lbs is calculated from the current estimates of the consist's mass and the anticipated initial speed. Each crush zone is designed to absorb at least 2.5 million ft-lbs. Approximately 14 feet of crush are estimated to be distributed among the crush zones.

GROSS MOTIONS

Figure 11 shows the simulation results for the velocity time-histories of each of the cars in the CEM passenger consist and the lead locomotive of the initially stationary freight consist. The lead car impacts the freight consist and begins to crush causing it to initially decelerate the fastest. As each crush zone is progressively triggered, each successive car decelerates at a similar rate to the first car. With the preliminary force crush behavior used in this simulation, the last crush zone did not trigger. Consequently, the trailing car and the locomotive decelerate together, essentially moving as a single mass. Both the passenger and freight consists move together down the tracks at approximately 10 mph by 0.75 seconds after the impact. The corresponding conventional test took nearly 2 seconds for the crushing to complete and two consists to reach the same speed.

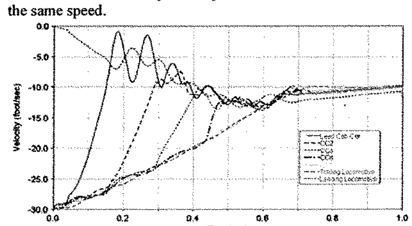

Figure 11. Velocity Predictions

The decreased overall collision time of the CEM test indicates that the passengers will experience more severe decelerations than in the conventional test. Figure 12 shows a plot of the secondary impact velocities (SIVs) in the cab car led train for both the conventional and CEM consists. Secondary impact refers to the impact between the occupant and some part of the interior, usually the forward seat, table or bulkhead. Secondary impact velocity is the relative velocity difference between the occupant and the rail car itself at the point of impact. Generally, higher secondary impact velocities correlate with increased injury risk. The SIV gives an initial indication of the relative severity of the occupant environment.

The average allowable occupant displacement (if compartmentalized) for common seating configurations is indicated in Figure 12. The largest distance traveled is associated with seats located behind a bulkhead; this seating configuration accounts for the fewest number of seats in a car. The most common seating configurations in commuter and

intercity cars are forward-facing seats and allow for 2-2.5 feet of respective longitudinal occupant displacement. Occupants seated at tables may travel 10-12 inches. Rear-facing seats allow for no relative displacement, providing the highest level of safety associated with secondary impacts.

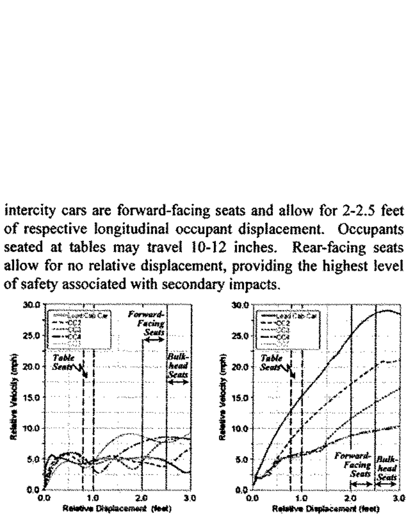

Figure 12. Secondary Impact Velocities of Conventional (left) and CEM (right) Passenger Cars

The ability of the CEM passenger cars to preserve the occupied volume of the car comes at a cost of a more harsh secondary impact environment for some of the cars in the consist. In a collision involving a multiple-car passenger consist, the most severe secondary impacts will be seen towards the front of the consist, while the secondary impacts will be gradually less severe for cars towards the rear of the consist. As can be seen in the secondary impact velocity plot presented in Figure 12, the CEM cab car is predicted to have an occupant environment notably more severe than that of the conventional cab car under similar test conditions. The first and second coach cars have SIVs that are between the cab car and the coach cars furthest from the impact. The third and fourth CEM coach cars have essentially the same SIV as their counterparts in the conventional consist.

REQUIREMENTS FOR OCCUPANT PROTECTION EXPERIMENTS

In the CEM full-scale two-car impact test, five occupant experiments were carried out in various seating arrangements. These arrangements consisted of forward-facing intercity seats, forward- and rear-facing commuter seats, and facing commuter seats with intervening workstation tables. The results of these experiments indicated several areas for improvement of the seating arrangements [15]. The occupant experiments to be conducted on the CEM full-scale train-to-train impact test will consist of a similar group of seating arrangements, including the suggested improvements. The occupant experiments and their placement in the cars are depicted in Figure 13 and Figure 14.

There are two necessary elements to protect occupants during a collision. It is first necessary to compartmentalize the occupants. Compartmentalization refers to limiting the trajectory of the occupant, usually within the space between the launch seat and the impacted seat. If compartmentalization is lost, the occupant kinematics are less predictable, and there exists a risk of striking more volatile surfaces. Compartmentalization has been shown to be an effective occupant protection strategy [16]. Second, the loads and accelerations imparted on the occupants by the seating arrangements that act in compartmentalizing the occupants must be within maximum injury criteria values. These two necessary elements are evaluated by the five occupant experiments.

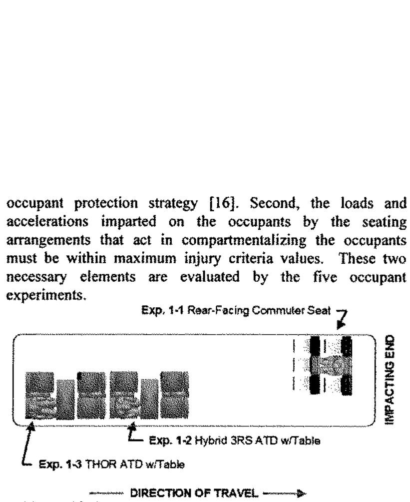

Figure 13. Location of Cab Car Occupant Experiments

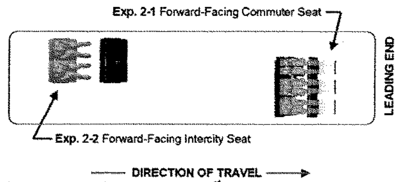

Figure 14. Location of 1st Coach Car Occupant Experiments

DESCRIPTION OF OCCUPANT EXPERIMENTS

All five of the occupant experiments use versions of seating arrangements that have been previously included in the conventional full-scale tests, CEM full-scale tests, and in sled testing. These seats have been modified as determined necessary from each testing iteration. A secondary objective of these tests is to gather data to refine computer models of each occupant experiment. As more test data is collected on each seat type and configuration, the computer models can be used more reliably to estimate the injury risk of many different collision scenarios. This data can also be used to evaluate the effectiveness of seat modifications.

The occupant experiments will include several different anthropomorphic test devices (ATDs, or test dummies) to measure the occupant response during the collision. These ATDs will be instrumented to measure head acceleration, chest acceleration, neck loads and moments, femur loads, chest compression, abdominal compression, and abdominal loads where appropriate. The seating arrangements will be instrumented to measure the attachment loads of the seats and tables, as well as the local car body accelerations. Additionally, high-speed video cameras will record the motion of the occupants during the collision, which will later be measured using photometric methods. The data captured during these experiments will be analyzed to determine the injury risk to occupants in each of the seating arrangements, as well as to refine computer simulations.

Experiment 1-1 – Rear-Facing Commuter Seats, One 50th Percentile Male ATD, Cab Car

Since the secondary impact environment in the cab car during the collision of a CEM passenger consist is more severe than in conventional equipment, further steps must be taken to protect the occupants. Previous testing has shown that rear-facing seats are an effective occupant protection strategy [17]. In order to verify this occupant protection strategy, a rear-facing seating arrangement will be included on the cab car in the CEM train-to-train impact test. Figure 15 is an illustration from the simulation model of this occupant protection experiment.

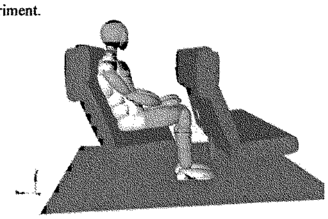

Figure 15. Experiment 1-1 – Rear-Facing Commuter Seats

Experiment 1-1 will consist of two rows of rear-facing three-person M-Style commuter seats. One Hybrid III 50th percentile male ATD will be seated at the middle position in the row nearest the impacted end of the cab car. This row of seats will be modified based on the results of previously conducted experiments (including conventional full-scale tests, CEM full-scale tests, and sled tests) as well as a series of computer simulations. A commuter seat that employs an optimized force-deflection characteristic is currently under development; this seat will both compartmentalize and minimize the injury risk to the occupant. The objectives of this experiment are to ensure that the seat attachment strength and degree of seatback deformation are sufficient to compartmentalize the occupant, to determine the overall occupant injury risk, and to show that rear-facing seats are an effective occupant protection strategy.

Experiments 1-2 and 1-3 – Facing Seats with Tables, Hybrid 3RS and THOR ATDs respectively, Cab Car

Two new experiments were conducted on the CEM full-scale two-car impact test. These experiments examined the occupant response in the facing-seat arrangement with an intervening workstation table. The impetus for these experiments was a rail accident in which a MetroLink passenger train collided with a BNSF freight train in Placentia, CA on April 23, 2002. Two of the three fatalities, along with several serious injuries, were likely caused by thoracic and abdominal injuries due to impact with a workstation table [2]. The results of these experiments confirmed a high risk of serious to fatal thoracic and abdominal injury from impact with the workstation tables. Figure 16 is an illustration from the simulation model of this occupant protection experiment.

An improved workstation table is currently in development. The improved table will remain attached to the wall and floor of the car to ensure that the occupant is compartmentalized; distribute the abdominal load over a larger area to decrease penetration into the abdominal cavity; and limit the load imparted on the occupant during impact. These characteristics will reduce the risk of serious to fatal thoracic and abdominal injury. These experiments will include both the THOR 50th percentile male ATD and the Hybrid III Rail Safety 50th percentile male ATD that were used in the CEM full-scale two-car impact test, so that the benefit of the improved workstation table can be assessed directly.

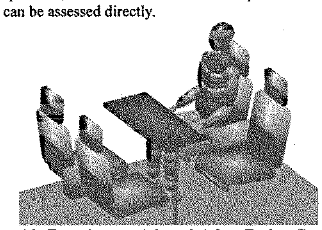

Figure 16. Experiments 1-2 and 1-3 – Facing Seats with Tables

The objectives of Experiments 1-2 and 1-3 are to determine the crashworthiness behavior of the modified workstation tables in the facing-seats configuration, as well as to verify the decrease in injury risk to the occupants impacting the tables. Another objective of the table experiments is to continue collecting and comparing test data from the two experimental ATDs (THOR and Hybrid 3RS) subjected to the same collision conditions.

Experiment 2-1 – Forward-Facing Commuter Seats, Three 50th Percentile Male ATDs, 1st Coach Car

On the CEM full-scale two-car impact test, the severe secondary impact environment of the trailing car brought about significant deformation of the forward seatback in the forward-facing commuter seat arrangement. This effect was also seen in the full-scale one-car test of conventional equipment, which had a similarly severe secondary impact environment [18]. This seatback deformation led to the loss of compartmentalization of all three occupants in this seating arrangement. As compartmentalization is the first requirement for occupant protection, modification of the forward-facing commuter seats is necessary. Figure 17 is an illustration from the simulation model of this occupant protection experiment.

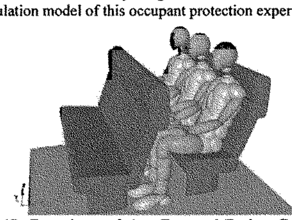

Figure 17. Experiment 2-1 – Forward-Facing Commuter Seats

The forward-facing commuter seats included in Experiment 2-1 will be identical to the seats used in Experiment 1-1. These seats have been modified to employ an optimized force-deflection characteristic that will both compartmentalize and minimize the injury risk to the occupant. The objectives of this experiment are to ensure that the seat attachment strength and degree of seatback deformation are sufficient to compartmentalize the occupants; to determine the overall injury risk to the occupants; and to ensure that the optimized force-deflection characteristic of the modified commuter seat is effective to protect occupants in both forward-facing and rear-facing arrangements.

Experiment 2-2 – Forward-Facing Intercity Seats, Two 95th Percentile Male ATDs, 1st Coach Car

On the CEM full-scale two-car impact test, forward-facing intercity seats were successful at compartmentalizing two 95th percentile male ATDs. Most of the injury measurements were below the maximum injury criteria values. However, the measured acceleration brought about from the impact of the heads of the ATDs and the forward upper seatbacks indicated a HIC of four to five times the acceptable tolerance level. The duration of the measured head accelerations was extremely short, and associated with a very small overall change of velocity. Computer simulations have shown that employing a softer impact stiffness between the head and the upper seatback can greatly reduce the risk of serious to fatal head injury without increasing neck loads. Figure 18 is an illustration from the simulation model of this occupant protection experiment.

The forward-facing intercity seats, which will be installed in the 1st coach car of the passenger consist, will be modified based on the results of previously conducted experiments as well as on a series of computer simulations. Additional padding will be added to the upper seatback of the forward seat to protect against a severe head impact. The objectives of this experiment are to ensure that the degree of seatback deformation is sufficient to compartmentalize the occupants, as well as minimize the overall injury risk to the occupants.

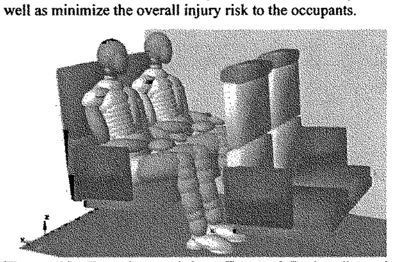

Figure 18. Experiment 2-2 – Forward-Facing Intercity Seats

SUMMARY

The foremost goal of improving rail passenger equipment crashworthiness is to preserve the occupant volume during a collision. The secondary goal is to enable the passengers to ride out the collision by minimizing secondary impact velocities and providing a "friendly" interior environment. Crash energy management along with strategic modification of rail passenger interior components has the potential to significantly increase occupant protection during an accident.

An ongoing series of in-line full-scale impact tests of conventional and CEM passenger equipment is nearing completion. In the sixth and final in-line test, currently scheduled for late 2005, a cab car led passenger consist will impact a standing locomotive led consist. The CEM coach car end structure that was tested in both one-car and two-car full-scale impact tests will be installed on the ends of each passenger car. A CEM end structure designed specifically for a cab car is currently being developed. It will include additional components such as deformable anti-climbers and a pushback operator's cage. This energy absorbing cab car structure will be installed on the colliding interface, as well as the interface between the fourth coach car and the trailing locomotive.

In the train-to-train test of conventional equipment, the space for approximately 46 passengers and the operator was destroyed. Under the same impact conditions, the CEM equipment is expected to preserve the space for all of the occupants. However the secondary impact velocities in the cab car and first coach car are likely to be higher than in the conventional equipment.

In order to reduce the injury risk to the occupants in this more severe environment, modifications to the interior arrangements are being made to keep secondary impact forces and decelerations within survivable limits. Five experiments will be included on the full-scale train-to-train impact test to measure the occupant response in modified versions of previously-tested seating arrangements: forward-facing intercity seats, forward- and rear-facing commuter seats, and facing commuter seats with intervening tables. These modifications are expected to minimize the injury risk to the occupants.

As part of the rail passenger equipment crashworthiness research, studies have been conducted to evaluate the influence of operational factors in train-to-train collisions [19, 20, 21]. These studies show that CEM cars can be introduced into service with minimum risks and with great potential benefit. The crashworthiness performance of a consist which is a mix of conventional and CEM equipment is never worse than the performance of an all conventional equipment consist in a train-to-train collision, and is always better when a CEM car is the impacting cab car. The impacting end of a CEM car can absorb more energy before intrusion into the occupant volume than the impacting end of a conventional car. Consequently, the impact speed required to cause intrusion into the occupant volume of a consist with a CEM car leading is higher than the impact speed required to cause intrusion into the occupant volume of a consist with a conventional car leading. How much higher this impact speed is for the consist with a CEM car leading depends on how many CEM cars immediately follow the leading car. The results of these studies also show that crush zones are beneficial for both MU and push-pull service, and that CEM makes train crashworthiness nearly independent of the range of train lengths typically used in passenger service.

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The scope of this paper ranges from collision simulations, to design development, to rail carbody construction, to fullscale testing. Eloy Martinez, Senior Engineer, Volpe Center, initiated and is monitoring the efforts to develop and fabricate the crush zones. Kristine Severson is leading the efforts to develop improved occupant protection in rows of passenger seats. Robert Rancatore, Project Leader, TIAX, LLC, is leading the effort to develop the cab car crush zone design, and to fabricate the crush zone components. TRA Associates is supporting TIAX in the design of the cab car crush zone. Ebenezer Rail Car is supporting TIAX in the construction of the crush zone components. Tom Roderick, Senior Technician and Joe Hanratty, Senior Technician, TTCI are integrating the crush zones into the cars. Gunars Spons, Federal Railroad Administration Resident Manager at the Transportation Technology Center, is managing the full-scale test effort.

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Evaluating Abdominal Injury in Workstation Table Impacts

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ABSTRACT

In rail passenger seating arrangements with workstation tables, there is a risk of serious thoracic and abdominal injury. Strategies to mitigate this injury risk are being developed through a cooperative agreement between the Federal Railroad Administration (FRA) of the United States and the Rail Safety and Standards Board (RSSB) of the United Kingdom. The approach to developing the protection strategies involves collision investigations, computer simulations of the occupant response, and full-scale testing. During the train collision in Placentia, CA on April 23, 2002, many occupants impacted workstation tables. The investigation indicated the likely modes of injury due to these impacts, the most traumatic being damage to the liver and spleen. A MADYMO computer simulation was created to estimate the loads and accelerations imparted on the occupants that bring about these injuries. Two experiments were designed and executed on a full-scale impact test with an occupant environment similar to the Placentia collision. These experiments incorporated advanced anthropomorphic test devices (ATDs) with increased abdominal instrumentation. The THOR ATD showed a more human-like impact response than the Hybrid III Railway Safety ATD. The full-scale test results are used to refine a MADYMO model of the THOR ATD to evaluate improved workstation tables. The occupant protection strategy that will be developed requires that the table remain rigidly attached to the car body, and includes a frangible edge with a force-crush characteristic designed to minimize the abdominal load and compression. MADYMO simulations of this table design show a significantly reduced risk of severe abdominal injury.

Evaluating Abdominal Injury in Workstation Table Impacts

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Abstract. In rail passenger seating arrangements with workstation tables, there is a risk of serious thoracic and abdominal injury. Strategies to mitigate this injury risk are being developed through a cooperative agreement between the Federal Railroad Administration (FRA) of the United States and the Rail Safety and Standards Board (RSSB) of the United Kingdom. The approach to developing the protection strategies involves collision investigations, computer simulations of the occupant response, and full-scale testing. During the train collision in Placentia, CA on April 23, 2002, many occupants impacted workstation tables. The investigation indicated the likely modes of injury due to these impacts, the most traumatic being damage to the liver and spleen. A MADYMO computer simulation was created to estimate the loads and accelerations imparted on the occupants that bring about these injuries. Two experiments were designed and executed on a full-scale impact test with an occupant environment similar to the Placentia collision. These experiments incorporated advanced anthropomorphic test devices (ATDs) with increased abdominal instrumentation. The THOR ATD showed a more human-like impact response than the Hybrid III Railway Safety ATD. The full-scale test results are used to refine a MADYMO model of the THOR ATD to evaluate improved workstation tables. The occupant protection strategy that will be developed requires that the table remain rigidly attached to the car body, and includes a frangible edge with a force-crush characteristic designed to minimize the abdominal load and compression. MADYMO simulations of this table design show a significantly reduced risk of severe abdominal injury.

INTRODUCTION

In Placentia, California on April 23, 2002, a standing passenger train was impacted head-on by an approaching freight train on the same track. One hundred and nineteen minor, twenty-two serious, and two fatalities were directly attributed to this collision (*1*). Both of the occupants who sustained fatal injuries were seated at workstation tables. As shown in **Figure 1**, workstation tables are placed in between facing pairs of seats (also known as open bay seats when a table is not present) in many passenger rail cars. Rail seats with tables have contributed to occupant injury in several rail collisions in recent history (*2*). For these reasons, workstation tables have been identified as an area for improvement with respect to occupant safety during a collision.

Injuries caused by impacts with workstation tables are also a concern with the United Kingdom. A Memorandum of Cooperation (MOC) has been adopted between the Federal Railroad Administration, U.S. Department of Transportation, and the Strategic Rail Authority, United Kingdom (UK). In the UK, the MOC is being effected at a working level through the Rail Safety and Standards Board Research and Development Program. Among other areas of cooperation such as glazing, grade-crossing safety, fire safety and emergency evacuation, these agencies will coordinate research and development efforts in the design of improved workstation tables.

There are three necessary elements to protect occupants during a collision. It is first necessary to preserve the occupant volume, which is the area of the train where passengers may be sitting or standing. Once the occupant volume is preserved, it is then necessary to compartmentalize the occupants. Compartmentalization refers to limiting the trajectory of the occupant, usually within the space between the launch seat and the impacted seat. If compartmentalization is lost, there exists a risk that the occupant kinematics are less predictable, and there is a risk of striking more volatile surfaces. Compartmentalization has been shown to be an effective occupant protection strategy (*3*). Finally, the loads and accelerations imparted on the compartmentalized occupants must be within survivable limits.

An important step in the development of an improved workstation table was to conduct a full-scale test of the existing equipment. In order to examine the interaction of the occupant with the workstation table, this full-scale

test implemented advanced anthropomorphic test devices with an increased capacity for recording abdominal loads and displacements over the standard Hybrid III 50^{th} percentile male ATD. Results from the full-scale test of the existing equipment are then used to refine a MADYMO (*4*) computer model of the occupant response. This refined model will be used to evaluate improved workstation table designs. An improved workstation table will be developed to compartmentalize the occupants as well as reducing the risk of thoracic and abdominal injuries.

ABDOMINAL INJURY ASSESSMENT

Human Tolerance to Frontal Abdominal Impact

Blunt trauma to the abdomen can bring about severe injury in several ways. Many of these modes of injury were seen in the occupants seated at workstation tables during the Placentia, CA collision. As the abdominal cavity is compressed between the spine and, in this case, the table edge, overall pressure increases. Increased pressure can cause the organs of the abdominal cavity to burst. The compression of the abdomen will initially bring about fractures of the lower ribs, and allow the organs of the abdominal cavity to be compressed and pushed against the spine and fractured ribs, causing ruptures and lacerations. As occupant is likely to impact the workstation table in the upper abdomen region, the liver is initially at risk, followed by the spleen and diaphragm (*5*). For high velocity impacts, the rate of compression of the abdomen can also bring about tearing of the abdominal organs (*6*).

The two fatally injured occupants of the Placentia, CA collision sustained such trauma. One occupant, a 48-year-old male, suffered 9 fractured ribs, lacerations of the liver and spleen. The other occupant, a 59-year-old male, suffered 14 fractured ribs, fractures of two thoracic vertebrae, lacerations of the liver and spleen, and a heart contusion (*7*). The non-fatal injuries sustained also included fracture ribs, as well as facial injuries from impact of the head with the top of the table.

Developing occupant protection strategies is aided by the ability to quantify injury risk. In the past, injury criteria for the testing of rail seats have been adopted from the automotive industry. The modes and severities of rail injuries are similar enough to automotive injuries that the criteria correlate well. In the case of abdominal injury brought about from impact with a workstation table, there are no widely accepted criteria that effectively characterize the injury risk. As airbags have been effective in preventing abdominal impacts with steering wheel rims, the attention of the automotive industry has shifted to lateral impacts. There is a concern for injuries brought about from submarining of seat belts; however, workstation table impacts are much more likely to occur in the upper abdominal region, thus injury criteria characterizing the lower abdomen is marginally useful.

Three measures will be used to assess the risk of abdominal injury: compression, rate of compression, and force. Since there are no widely accepted maximum injury criteria levels, these measures of the abdominal response to the impact with the current and improved workstation tables will be compared. Ideally, an improved workstation table will limit the abdominal force, which in turn reduces the compression and rate of compression. In order to record meaningful measurements, it is necessary to use ATDs that have a biofidelic abdominal impact response and are capable of measuring abdominal compression.

Advanced ATDs

Hybrid III with Frangible Abdomen

The first ATD to include a method for evaluating abdominal injury was a modified Hybrid III with a frangible abdomen insert (*8*). The frangible abdomen insert is constructed of crushable foam with a defined force-crush characteristic, generally characterized by 30N/mm stiffness. Examination of the foam after the impact test indicates the peak deformation and accordingly an estimate of the peak load. The frangible abdomen insert proved to be most effective in indicating when submarining would occur. The drawback of the frangible insert is that it is difficult to record a time-history of the abdominal penetration or force. Further development of a rate-sensitive abdominal insert for the Hybrid III family of ATDs is currently being developed (*9*).

Hybrid III Railway Safety

The development of the Hybrid III Railway Safety (Hybrid 3RS) ATD was funded and directed by the United Kingdom's Rail Safety and Standards Board, with the assistance of Transportation Research Laboratories, Ltd., along with GESAC, AEA, Millbrook and MIRA. The Hybrid 3RS is a modified version of the stock Hybrid III 50th percentile male ATD, aimed at characterizing injuries perceivable in rail collisions, specifically with fixed tables in seating bays and with seat back tables. Practical problems were encountered with the stock Hybrid III in obtaining concurrent information from the frangible abdomen device and with lower chest intrusions. The developed Hybrid 3RS is equipped with similar instrumentation to the THOR. The Hybrid 3RS is in the experimental stages, and there is only one currently in existence.

The ribcage of the Hybrid 3RS ATD has not been modified from the stock Hybrid III 50th percentile male ATD. However, CRUX units have been added at four locations to measure three-dimensional rib displacements. The lower abdomen insert from the THOR ATD, which consists of layered deformable foam enclosed in a Cordura nylon bag with seams sewn with Kevlar thread, is mounted between the lower rib cage and the pelvis. This insert has two double gimbaled string potentiometer (DGSP) units, one on each side, to measure the three-dimensional displacement of the lower abdomen, as well as two linear string potentiometers at the mid-abdomen level. The Hybrid 3RS includes a three-piece plastic bib that overlaps in front of the gap between the bottom of the ribcage and the top of the lower abdomen insert, preventing impactor penetration. The Hybrid 3RS also incorporates the THOR hip arrangement, improving biofidelity over the stock Hybrid 3. An image of the Hybrid 3RS, detailing the location of these transducers, is shown in **Figure 2**. **Figure 3** shows the force-penetration characteristic of the lower abdomen of the Hybrid 3RS against the expected human impact response determined from previous studies using post-mortem human surrogates.

THOR

The THOR (Test Device for Human Occupant Restraint) 50th percentile ATD was developed by the National Transportation Biomechanics Research Center of the National Highway Traffic Safety Administration (*10*). The THOR was originally developed to investigate the injury risk associated with restraints, such as seat belts and airbags, to the thorax and abdomen. The THOR is currently in the experimental stage of development, and has not been validated as thoroughly as the Hybrid III.

The THOR ATD includes several refinements over the standard Hybrid III and Hybrid III with the frangible abdomen insert. The overall biofidelity of the ATD has been improved, as shown in the THOR Biomechanical Requirements document (*11*). The rib cage of the THOR is representative of the human thoracic structure, and includes three-dimensional displacement measurement at four locations. There are two abdomen inserts: the smaller upper abdomen insert is mounted in the center of the lowest three ribs, and the lower abdomen insert is mounted between the lower rib cage and the pelvis. Both inserts consist of layered deformable foam enclosed in a Cordura nylon bag with seams sewn with Kevlar thread. The upper abdominal insert includes a unidirectional string potentiometer to measure displacement, as well as a uniaxial accelerometer. The lower abdominal insert has two DGSP units, one on each side, to measure the three-dimensional displacement of the lower abdominal surface. An image of the THOR, detailing the location of these transducers, is shown in **Figure 4**.

The improved biofidelity and the comprehensive thoracic and abdominal instrumentation make the THOR a good candidate for testing workstation tables. The upper abdomen impact response is of specific interest, as impact with the workstation table would likely occur directly on the upper abdomen insert. **Figure 5** shows the upper abdomen impact force-penetration response of the THOR in three tests. These tests are compared to the corridor of upper abdominal force-penetration from post-mortem human surrogates from data developed by Nusholtz (*11, 12*). This data is taken from 18 kg rigid steering wheel impacts at 8.0m/s. The peak load of this impact is roughly 11kN, reached at between 105mm and 110mm. The THOR impact response is within the prescribed corridor for penetrations of less than 90mm.

An additional benefit of using the THOR in testing workstation tables is that TNO Automotive has developed a THOR Alpha model in MADYMO 6.1 (*4*). Previous workstation table simulations using TNO's Hybrid III model indicated the need for a more detailed model to represent the impact of table on the abdomen (*13*). TNO's THOR model includes corresponding output channels for the THOR ATD's thoracic and abdominal instrumentation. Preliminary simulations have shown promising results.

FULL-SCALE TEST

Test Objectives

There were three primary objectives in running a full-scale test of the workstation table environment. The first was to observe the occupant response during a collision of similar magnitude to the Placentia, CA collision. Correlations can be made between the loads and accelerations experienced by the ATDs in the test and the actual injuries sustained by the occupants seated at workstation tables in the Placentia collision. The second objective was to measure the loads imparted on the table by the occupant. This information is necessary for the design of an improved workstation table. The final objective was to add to a growing database of information on the occupant response during rail collisions. A collection of test data from as many different test conditions as possible is very helpful in developing strategies to protect occupants in rail collisions.

The full-scale workstation table tests were conducted as a part of a larger full-scale test of two coupled passenger cars with modified end structures, as shown in **Figure 6**. The design of the end structures is known as crash energy management (CEM), a system by which energy is absorbed through the controlled crush of the end frames. The most important aspect of CEM system is that it preserves the entire occupant volume. More information on the end structure design and performance can be found in References 14 and 15. Since the CEM design satisfies the first element to occupant protection, focus is shifted to compartmentalization and injury risk.

Occupant Environment

The THOR and Hybrid 3RS experiments were set up towards the aft end of the leading car in the CEM two-car full-scale test. The seats and tables, provided by Metrolink, were identical to those installed on the impacted passenger car in the Placentia, CA collision. The attachments of the seats to the seat rails in the floor and the side frame on the wall were consistent with in-service mounting. The table attachment points were strengthened to ensure that the table would not detach during the impact. This was necessary both to ensure that the ATDs were compartmentalized and that the load cells at the table attachment points would accurately read the maximum force imparted on the table by the occupants. In a sled test of these Metrolink seats without reinforced table attachments, the table failed before it arrested the motion of the occupants, thus the maximum load was not determined (*16*).

While the longitudinal acceleration pulse experienced by the ATDs in the CEM two-car full-scale test was notably severe, it was less severe than the estimated acceleration pulse in the Placentia, CA collision (*12*). Furthermore, there were additional vertical and lateral accelerations experienced by the occupants in the Placentia collision because of the unique mode of deformation of the impacted car. Since the CEM end structures are designed for controlled crush, vertical and lateral accelerations are negligible. The occupant environment in the CEM two-car full-scale test was not meant to reenact the Placentia collision; rather, it was a convenient and economic venue on which to carry out the workstation table experiments. Nonetheless, the measurements taken by the ATDs should be consistent with the modes and severities of the injuries sustained by the occupants in the Placentia collision, as frontal impact of the workstation table to the upper abdomen of the occupants is the prevailing factor.

Hybrid 3RS

A MADYMO model of the Hybrid 3RS does not currently exist, thus pre- and post-test simulations were not conducted. There is the potential for modification of TNO's Hybrid III model to account for the differences in thoracic and abdominal impact response and instrumentation at a later date.

Kinematics. As the leading car in the two-car consist impacts the wall, the Hybrid 3RS ATD initially translates forward with an increasing velocity relative to the car. The shoes drag on the floor, and do not translate forward as quickly as the femurs. The upper abdomen impacts the table slightly before the lower legs impact the facing seats. As the upper abdomen impacts the table, the pelvis continues to translate forward for several milliseconds before coming to rest relative to the abdomen. The upper body rotates a small amount about the point of impact with the table, and the head rotates forward about the torso upon maximum compression of the abdomen. The Hybrid 3RS quickly rebounds off of the table and returns to the initial position. **Figure 7 (top)** shows the time-history of the Hybrid 3RS kinematics during the impact.

Injury Measurements. The upper abdominal compression (read at the lower CRUX units) reached a maximum of 73mm on the right and 79mm on the left. The maximum viscous criterion calculated was 1.08m/s. The highest resultant chest acceleration maintained over a 3ms window is 46.48g, measured between 103.5ms and 107ms. The peak upper abdominal load reached 29.25kN. The maximum calculated HIC15 was 288.

Discussion. As opposed to the THOR, the abdominal compression measured by the CRUX units in the Hybrid 3RS is in good agreement with the high-speed film. The PTFE bib successfully prevented penetration of the table edge between the bottom of the rib cage and the top of the abdominal insert. While the chest acceleration and HIC measurements were relatively low, the high abdominal load and abdominal compression are of great concern. The Hybrid 3RS performed well in this test, with no signs of wear or necessary maintenance.

THOR Response

Pre-Test Predictions

A MADYMO occupant response model was created before full-scale test was run. The seat model was created and refined based on three sled tests of facing commuter seats (*16*). However, the facing seats sled test simulation that included a workstation table was not refined as part of this report. This model has been used for several other purposes, including an estimated recreation of the occupant response during the Placentia collision (*13*). This full-scale test was the first opportunity to refine the workstation table element of the facing seats model based on test measurements.

The tabletop is defined as a lumped mass rigid body, since the tabletop itself was not expected to deform during the impact. Point restraints at the location of each of the load cells in the test support the tabletop. An unmodified THOR ATD model is positioned on the window side of the seat pair, facing the impacted end of the car. A three-dimensional collision dynamics model of the CEM two-car full-scale test produced the input to the occupant response model (*15*).

Kinematics. During the impact, the THOR translates forwards toward the table and impacts directly on the ellipsoid representing the upper abdomen insert. As the upper abdomen compresses, the ellipsoids representing the lower three ribs move in unison. The compression of the upper rib cage is completely independent of the motion of the lower three ribs. As the THOR rebounds from the table, the neck flexes forward, allowing the head to impact the tabletop.

Injury Predictions. During the impact with the table, the THOR upper abdomen (read at both the upper abdomen string potentiometer and lower CRUX units) compresses 78mm. The peak upper abdominal load reaches 22kN. The viscous criterion reaches a maximum of 2.36m/s, and the 3ms chest acceleration reaches 76g. A HIC15 calculation for the impact of the head with the tabletop results in a value of 733.

Discussion. All of injury predictions presented above exceed the maximum injury criteria values, which is consistent with the injuries seen in the Placentia collision. The occupant does, however, remain compartmentalized. This deformation of the lower thorax is questionable, and will be a focus of the model refinement after the test.

Full-Scale Test

During the CEM two-car full-scale impact test, the modified end structures of the passenger cars performed exactly as expected. The impact speed of the two coupled cars with the wall was 29.3 miles per hour. Nearly all of the data channels were successfully recorded, and both of the workstation table experiments were successfully captured on high-speed film.

Kinematics. As the leading car in the two-car consist impacts the wall, the THOR ATD initially translates forward with an increasing velocity relative to the car. The shoes drag on the floor, and do not translate forward as quickly as the femurs. Immediately after contact with the table occurs, the upper body begins to rotate down towards the tabletop and the pelvis and femurs rotate upwards towards the bottom of the table, forming a "C" shape about the point of contact. The upper body rotation continues rapidly until the head impacts the forward edge of the tabletop, and passes between the knees on the far side of the table. The THOR then rebounds gradually, and the final resting

position is partially slumped over the table. **Figure 7 (bottom)** shows the time-history of the THOR kinematics during the impact.

Injury Measurements. The upper abdominal compression (read at the lower CRUX units, since the upper abdominal string potentiometer saturated before the impact was complete) reached a maximum of 52mm on the right and 58mm on the left. The maximum viscous criterion calculated was 1.30m/s. The peak chest acceleration in the longitudinal direction was 93g, which occurred at a time of 103ms. The peak chest acceleration in the vertical direction was 293g, which occurred at a time of 109ms; however, this peak is less than 3ms in duration, and does not contribute to the 3ms chest injury criteria. The highest resultant chest acceleration maintained over a 3ms window is 73.27g between 102ms and 105ms. The peak upper abdominal load reached 30kN. The maximum calculated HIC15 for the impact of the head with the forward table edge was 530.

Discussion. The measurements from the lower CRUX units are not in agreement with the upper abdominal compression seen in the high-speed film. The upper abdomen appears to compress at least half of the depth of the THOR upon initial impact with the table. As the upper body rotates about the contact point, the table appears to penetrate through to the spine. This would indicate a compression of roughly 130mm. Inspection of the THOR after the impact offered further evidence. The THOR jacket, which is essentially a vest that covers the entire torso, was wedged between the upper and lower abdominal inserts. This suggests that the table itself penetrated the area below the bottom rib, where the lower CRUX units are attached, and traveled as far as the spine. This would account for the fact that the CRUX units did not measure the full extent of the upper abdominal compression. Additionally, it was found that the lumbar spine pitch change joint had fractured during the test. This joint, a significant structural element in the spine of the THOR, is constructed of 1¼-inch by 1¾-inch hardened steel (see **Figure 8**). Fracture of this piece suggests that the table directly impacted the spine. The high peak in the vertical direction of the chest acceleration time-history suggests that this joint fractured at a time of 109ms.

Post-Test Simulation Refinement

In the pre-test simulation of the THOR impact with the workstation table, the rotation of the upper body towards the tabletop and the pelvis and femurs towards the bottom of the table was not as pronounced as in the full-scale test. The measurements of the abdominal response to the table impact, however, were more severe than measured in the test in all categories except for chest acceleration. Refinement of the simulation entailed making changes to TNO's THOR model to allow the magnitude of rotation about the table contact point. The most significant change to the THOR was to allow rotation about the lumbar spine pitch change joint, which was fractured during the test. This allowed the THOR upper body to rotate about the table contact point close to the extent seen in the high-speed film. Another modification to the model was to increase the friction in the contact between the shoes and the floor. This brought the impact of the tibias with the facing seat pan to closer to the feet, allowing the pelvis and femurs to rotate upwards towards the bottom of the table.

The input to the post-test simulation was the crash pulse measured by the accelerometer at the center of mass of the lead car in the CEM two-car full-scale test. To smooth out the relatively noisy longitudinal acceleration pulse, it was integrated twice, and the relative displacement was applied to the reference frame of the seats and table. The lateral acceleration was not applied to the THOR, since the lateral motion relative to the car was negligible during the impact. A vertical acceleration pulse consisting of the measured vertical acceleration at the rear end of the lead car combined with gravitational acceleration was applied directly to the THOR.

Kinematics. As the THOR begins translating forward, the shoes drag on the ground and begin to rotate forward about the toes. The table impacts directly on the upper abdomen ellipsoid, and the lower ribcage begins to compress. At a time of 108ms, the lumbar spine pitch change joint becomes unlocked. This allows the severe upper body rotation towards the tabletop and pelvis rotation towards the bottom of the table, forming the "C" shape as seen in the full-scale test. As the upper body rotates forward, the head impacts the top of the table at a time of 153ms. The THOR then rebounds and comes to rest partially slumped over the table. A time-history of the post-test simulation kinematics is shown in **Figure 9**.

Injury Predictions. During the impact with the table, the THOR upper abdomen (read at both the upper abdomen string potentiometer and lower CRUX units) compresses 84mm. The peak upper abdominal load reaches 28.7kN. The abdominal viscous criterion reaches a maximum of 1.27m/s. The chest acceleration is very similar to the full-

scale test measurements. The peak chest acceleration in the longitudinal direction was 89g, which occurred at a time of 107.5ms. The peak chest acceleration in the vertical direction was 307g, which occurred at a time of 108ms; however, this peak is less than 3ms in duration, and does not contribute to the 3ms chest injury criteria. The highest resultant chest acceleration maintained over a 3ms window is 64.98g between 106ms and 109ms. A HIC15 calculation for the impact of the head with the tabletop results in a value of 953.

Discussion. Refining a simulation based on the THOR response in the CEM two-car full-scale test proved difficult. The kinematics of the THOR in the test were influenced by physical characteristics (i.e. the ability of the table to penetrate the space between the upper and lower abdominal inserts) that are not represented in TNO's THOR model. The time-histories of chest acceleration, head acceleration, and abdominal load of the refined model, as well as the overall kinematics, correlate very well with the full-scale test results. However, the abdominal compression in the model is much higher than that measured in the test. This evidence supports the theory that, in the full-scale test, the THOR CRUX units did not measure the full extent of the upper abdominal compression. It is unknown whether the modifications made to the THOR to reproduce the full-scale test response adversely affect the biofidelity of the model in other impacts.

Comparison of THOR and Hybrid 3RS

In the CEM two-car full-scale impact test, the response of the THOR and Hybrid 3RS ATDs differed significantly. In terms of abdominal impact response, the Hybrid 3RS showed a higher stiffness than the THOR. While this is a desirable feature for the repeatability of a test device, a stiffness that is too high can yield a response that is not representative of a human occupant. In laboratory tests using post-mortem human surrogates (PMHS), the measured stiffness of the middle and upper abdomen is between 50N/mm and 75N/mm for high-speed impacts (*5*). Since there is no upper abdominal insert in the Hybrid 3RS, the impact is concentrated on the rib cage, which was not modified from the stock Hybrid III. Thus, a high stiffness response of 380N/mm results. Assuming an upper abdominal compression of 130mm (enough to impact the spine), the THOR shows a stiffness of 230N/mm.

Although the Hybrid 3RS showed a stiffer abdominal response to the table impact, it proved to be very robust. Since it is based on a thoroughly validated ATD, the Hybrid 3RS benefits from years of testing experience. The THOR, however, is still in the experimental stages. This contrast can be seen in the fact that, unlike the Hybrid 3RS, the THOR required maintenance after the table impact in this CEM two-car full-scale test. One item of concern is that the table penetrated the gap between the upper and lower abdomen inserts and impacted the spine of the THOR. There are rib stiffeners installed in the jacket of the THOR to prevent exactly this; however, it is doubtful that these stiffeners are designed for as concentrated a load as the table edge. On the Hybrid 3RS, a PTFE bib successfully prevented penetration of the table into the gap above the lower abdomen insert. It is recommended that this bib be adapted for use with the THOR in future tests.

Both the THOR and the Hybrid 3RS ATDs will be included in future testing of workstation tables. This will allow a comparison of the recorded thoracic and abdominal measurements in order to quantify the performance of an improved table.

DEVELOPMENT OF IMPROVED WORKSTATION TABLE

The results of the workstation table experiments on the CEM two-car full-scale impact test confirmed the need to develop occupant protection strategies for this seating arrangement. As stated earlier, compartmentalization is the second necessary element of occupant protection, after preserving occupant volume. This strengthening of the table attachments in the CEM two-car full-scale test successfully compartmentalized both of the ATDs. Compartmentalization by the table prevented further impacts of the ATDs with additional interior structures of the train. Had the table not compartmentalized the occupant, impacts with interior structures further away from the initial seating positions would have occurred at a higher velocity, thus creating an increased injury risk. Furthermore, the kinematics of these impacts are somewhat unpredictable, and the potential for serious head and neck injuries would be high.

On the other hand, the third requirement for occupant protection is that the loads and accelerations imparted on the occupants by the interior structures that provide compartmentalization must be survivable. The ATDs in the table experiments on the CEM two-car full-scale test showed a very high risk of thoracic and abdominal injury, indicating

that this third requirement was not fulfilled. Therefore, the workstation table seating arrangement must be redesigned to reduce the injury risk to the occupants.

The occupant protection strategy that will be carried out has two necessary elements. The first is that the table must remain firmly attached to the car body in order to compartmentalize the occupant. This must remain true independent of the number and mass of the occupants seated at the table. The second requirement is that the table limit the load imparted on the upper abdomen of the occupants. In the CEM two-car full-scale test, the measured loads reached and exceeded 30kN. This number exceeds any documented abdominal impact tests of PMHS or ATDs, and must be significantly reduced. Implementing a frangible edge on the table allows energy to be absorbed by the table during the impact, which limits the load imparted on the occupant.

A MADYMO simulation has been created to demonstrate this occupant protection strategy. An optimal force-crush characteristic is being currently developed for improved workstation table edge. Initial estimates suggest that a table edge that can crush 15cm at a load of 5.5kN can significantly reduce the thoracic and abdominal injury risk to occupants seated at the table during a collision. In the simulation of an 8g triangular acceleration pulse sled test, thoracic and abdominal injury risk is reduced significantly. Compared to the rigid table condition, the upper abdominal displacement is reduced from 80mm to 46mm; the upper abdominal viscous criterion is reduced from 0.62m/s to 0.33m/s; the 3ms chest acceleration is reduced from 38.1g to 21.5g; and the abdominal load is reduced from 19.5kN to 5.5kN. Once the improved workstation table design is finalized, the table will be constructed and tested in both static and dynamic environments. The improved tables will be included on the CEM train-to-train full-scale impact test to ensure that the injury risk measured by the THOR and Hybrid 3RS ATDs has been significantly reduced.

CONCLUSION

In a cooperative effort between the Federal Railroad Administration of the United States and the Rail Safety and Standards Board of the United Kingdom, several steps have been taken towards improving occupant protection in rail passenger seating arrangements with intervening workstation tables. Current workstation tables pose a severe injury risk to the upper abdominal region of 50th percentile male occupants. Such injuries have been witnessed in real-world accidents, such as the April 2002 collision in Placentia, CA. Full-scale testing has been conducted to measure the abdominal response to impact with workstation tables. This testing required the use of advanced ATDs with increased abdominal instrumentation over the standard Hybrid III 50th percentile male ATD. The THOR and Hybrid 3RS ATDs provide both the improved biofidelity and instrumentation necessary to evaluate workstation table performance.

The results from the occupant experiments on the CEM two-car full-scale test indicated that the current workstation table design was successful in compartmentalizing the occupants. However, impact with this table brought about an abdominal load higher than measured in any documented PHMS or ATD testing. The high abdominal load relates to a high risk of life-threatening injury, which indicates the need to design an improved workstation table.

The MADYMO computer simulation exercised before the CEM two-car full-scale test allowed a good estimation of the loads and accelerations imparted on the THOR ATD. The model was further refined based on the data collected in the test, and the subsequent simulation shows good agreement with all of the test measurements. This model will be used to evaluate improved workstation table designs. A MADYMO model of the Hybrid 3RS ATD will be created and refined in the future.

An improved workstation table will both compartmentalize the occupants and reduce this high abdominal load. The performance of the improved table will be examined in dynamic sled testing, as well as inclusion on the full-scale train-to-train impact test of crash energy management equipment. The Hybrid 3RS and THOR ATDs will be used on these tests to ensure that the abdominal load, compression, and rate of compression resulting from impact with the improved table are reduced.

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Ongoing work on occupant protection in rail passenger equipment is being conducted cooperatively with the United Kingdom's Rail Safety and Standards Board. This work is being coordinated with Alan Lawton, Head of Technical Services, Rail Safety and Standards Board.

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Figure 1. Facing seats with workstation table seating arrangement.

Figure 2. Diagram of Hybrid 3RS thoracic and abdominal instrumentation.

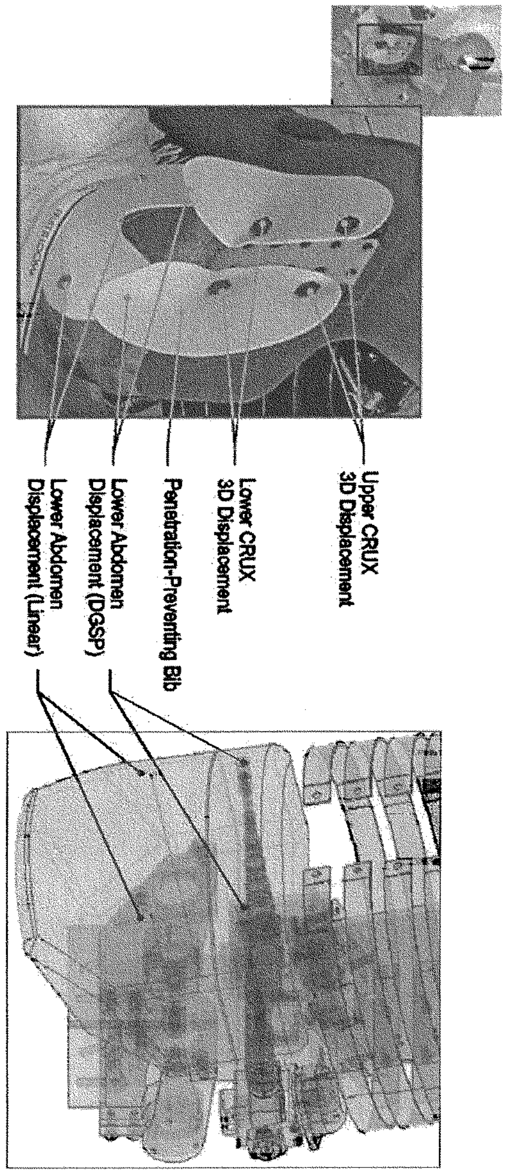


Figure 3. Graph of H3RS abdominal impact response

Testing Summary

Impact Speed (Average)	6.1 m/s	**Scan Rate**	10000 scans/sec
Impact Effective Mass	32 kg	**Filter**	CFC 180
Impactor	Cylindrical Rod, Length = 300 mm; Diameter = 25 mm		

Result Plots

Note: Response is compared with biofidelity corridor. The deflection is "external deflection" measured by a LVDT attached to the impactor head. The external deflection is slightly different from the "internal deflection" measured by the string potentiometers inside the abdomen.

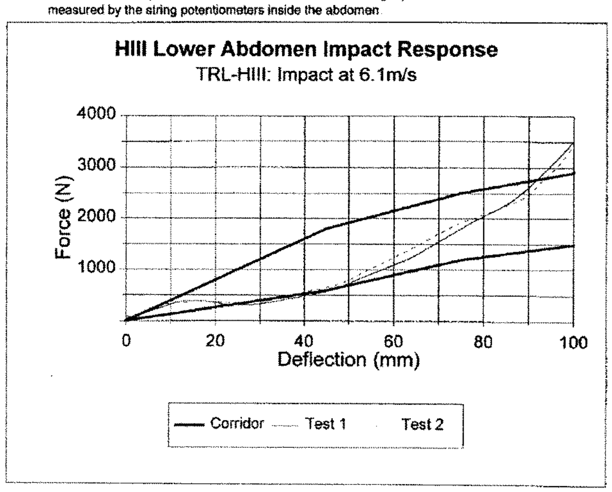


Figure 4. Diagram of THOR thoracic and abdominal instrumentation.

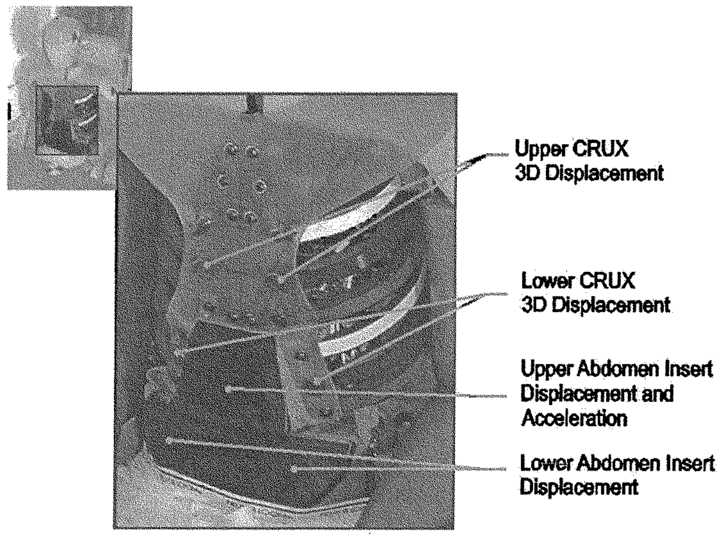


Figure 5. Graph of THOR upper abdomen impact response.

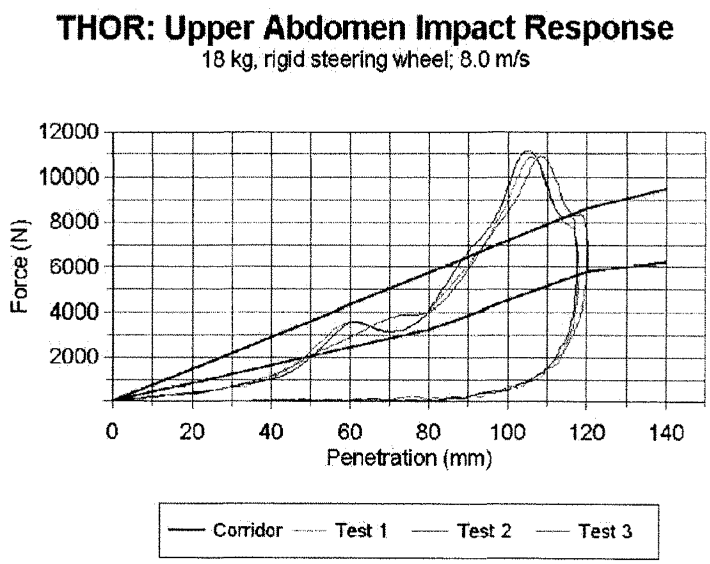


Figure 6. Diagram of the CEM two-car full-scale test setup.

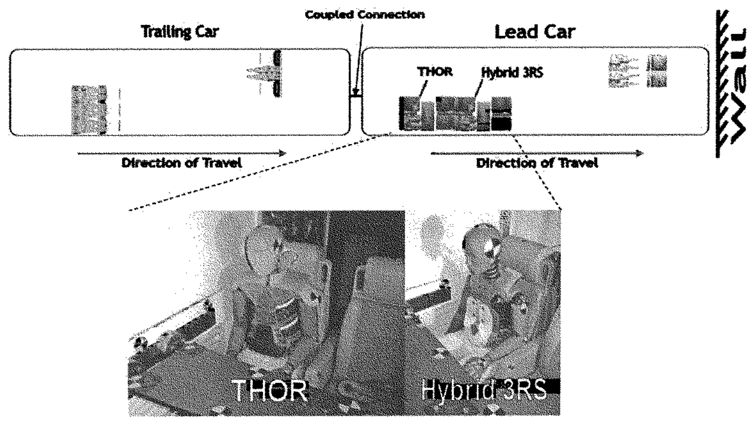


Figure 7. Kinematics of the Hybrid 3RS and THOR response in the CEM two-car full-scale test.

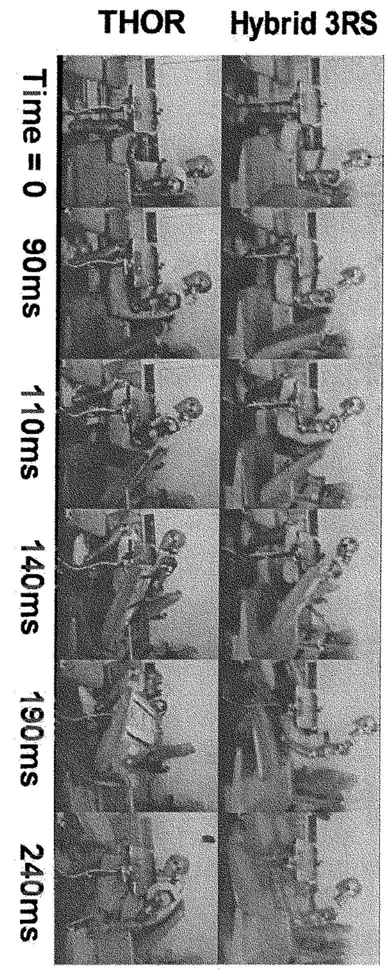


Figure 8. Image of the THOR lumbar spine pitch change mechanism after the CEM two-car full-scale test.

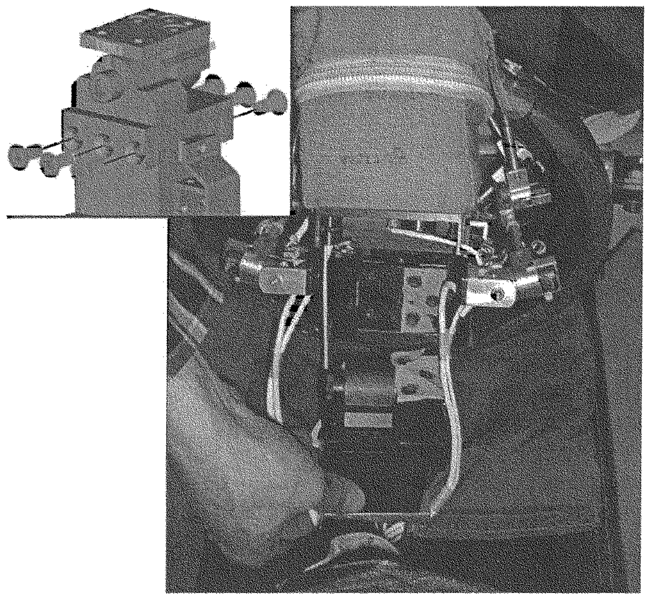
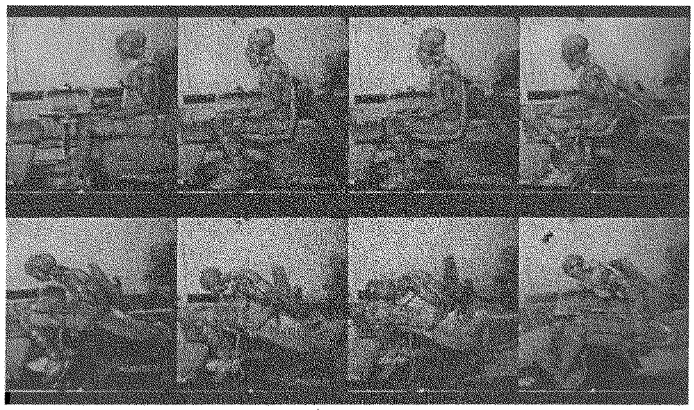


Figure 9. Kinematics of the THOR response in the post-test MADYMO simulation of the CEM two-car full-scale test.



Mr. MILLER. Thank you. I yield back, Mr. Chairman.

Mr. LATOURETTE. I thank you. Ms. Johnson?

Ms. JOHNSON. Thank you very much. In the accident in South Carolina, it raised a number of questions about Dark Territory. Has there been some technology that has been used to maybe deal with Dark Territory?

Ms. STRANG. Actually, there have been several things. First of all, we issued something called a broad agency announcement, which is a funding mechanism, looking for people to come to us with proposals on how to cure this problem. So we are looking for ways that we can make sure that switches are in the correct position even in dark territory and that appropriate alerts can be given to the train crews and others.

Ms. JOHNSON. You indicated that most of the accidents are caused by human factors. Can you name others that have been prominently noted?

Ms. STRANG. I am sorry. I am not sure I understand your question.

Ms. JOHNSON. You indicated that most of the accidents are caused by human factors. Has there been some observation that makes the human factors more common, and if so, has there been the application of any technology that can solve that, or are you still looking?

Ms. STRANG. There are technical solutions to human factor accidents. As Mr. Chipkevich mentioned, Positive Train Control is one of them. Basically, if you are relying on a person that does not have a redundant backup system, technology is probably going to provide the best solution. So we are looking at ways to improve switch position indicators, because that is the second-leading cause of accidents, and also track inspection information that can be gathered through better technologies. Track causes are the second-leading cause of train accidents.

Ms. JOHNSON. What is the infrastructure like with the rails, tracks?

Ms. STRANG. Well, do you mean how much is there?

Ms. JOHNSON. Well, what is the age? Do they need some type of attention or repair or change?

Ms. STRANG. Okay. The railroad has been around for a long time, 180 years, so there are various ages of track and rail components throughout the system. Railroads have made a lot of efforts to improve the strength, or the poundage, of the rail, going up to a heavier weight, up to 136 pounds, as they have increased axle loads. And it is a combination, I believe probably Dr. Samuels will talk about it a little more, that it is a combination of heavy axle loads and heavy rail that are needed to provide safe transportation.

[The information received follows:]

ANSWER: Newer and heavier rail sections are better suited to support heavy axle loads over longer periods of time. This is not to say that lighter rail sections are unsafe for supporting heavy axle loads; it simply means that the life cycle of lighter rail sections will be significantly reduced under such loading conditions.

Ms. JOHNSON. I am curious, because it seems to me that we are hearing more and more about rail accidents, and I was trying to see if there was a way in which to focus in on the common cause and if there was some technology or an improvement of the infrastructure or whatever to see if they could be avoided.

Ms. STRANG. I think there is. I believe some of the things we discussed today will go towards reducing those accidents as soon as we can get them deployed and out in use.

Ms. JOHNSON. Thank you very much.

Mr. LATOURETTE. I thank the gentlelady.

Ms. Strang, before I yield to Mr. Graves, for the benefit of the record and maybe some in the audience, could you just tell us what Dark Territory is.

Ms. STRANG. Dark territory is territory on a railroad that does not have a signal system, so you usually rely on track warrants or a paper system to control the operation of the train.

Mr. LATOURETTE. Thank you very much. Mr. Graves?

Mr. GRAVES. Thank you, Mr. Chairman.

What I am curious about, and you barely touched on it in your written testimony with some of the private initiatives being undertaken, I am interested in the electronic train management system, which is an overlay system that the BNSF is in the middle of. Can you talk to me about an overlay system, how that works? Can you also tell me how involved you are in that, and also where we are in that process as far as development goes?

Ms. STRANG. Sure. Okay. There are a number of efforts underway in the private sector. BNSF has the ETMS, or Electronic Train Management Systems; CSX is using Communications-Based Train Management, CBTM; the Alaska Railroad is pursuing another system. In the private sector, not a government partnership like the North American Joint Positive Train Control Program, BNSF's project is the furthest along.

An overlay system is a non-vital system that uses a communications base to control trains. It has an office segment, a communications part, equipment on the locomotive, and wayside detectors. BNSF's project is 130 miles in Illinois, I think it is around Beardstown. They began their project a couple of years ago; right now, they are at phase two of a three-phase test. So they are running trains with the train control system turned on under a waiver from FRA. FRA has been involved in helping them test in all phases of it. We actually have a test monitor that is out there riding trains with them all the time. We are also doing a human-machine interface study with them, where we are looking at the human aspect of their interface with the system.

Mr. GRAVES. What do you mean by non-vital, you said non-vital?

Ms. STRANG. "Non-vital" means that it is an overlay. The existing train control components are all still there: they are not taken away.

Mr. GRAVES. Talk to me about cost. Are these not a little bit less complex?

Ms. STRANG. They are less costly than a vital system in some ways; they are new. Because you do not have a vital system, some of the testing requirements are a little bit less, and the component communications part of it costs much less.

Mr. GRAVES. But there are, and I guess what I was getting at as much as anything else, there are a lot of things out there besides just what you all are doing, that the private industry is doing a lot to try to alleviate some of their accidents and doing some of the things that are going on, too.

Ms. STRANG. That is correct.

Mr. GRAVES. So there is a pretty heavy initiative going on?

Ms. STRANG. That is correct.

Mr. GRAVES. Thank you.

Mr. LATOURETTE. Thank you, Mr. Graves. Ms. Norton?

Ms. NORTON. Thank you very much, Mr. Chairman. I appreciate the opportunity to sit with this Subcommittee. Of course, I am a member of the full Committee.

I am sure that all of you are aware that as we speak there is a hearing going on which I think really says a great deal to us, should send a message to us about Federal inaction post-9/11 on rail and freight.

The District of Columbia, one jurisdiction, unable to see any action by the Federal Government, but also seeing freight carrying hazardous substances going within four blocks of the Capitol of the United States and throughout heavily congested neighborhoods, took action on its own and passed a law and said you have got to reroute that stuff. The Railroad Administration said, well, we do when there is a big event in the District of Columbia such as on the Mall. But of course when Congress is in session and the rest of that is going on, we had no evidence that had been done.

Some of us tried to get hearings. We wrote to Secretary Ridge and tried to get information. No information. The judge indicated that perhaps this thing could be negotiated and the information could be shared with the District and they would be able to understand that something had been done. The Government did not want to do that.

So the judge looked at it and the judge must have said the equivalent of is this it, because here you had a Federal District Court judge ruling against the railroad in this instance, although everybody thought it was a slam dunk on interstate commerce grounds. The judge found when there is a gap in the law and the Federal Government sits there and takes no action, then it must mean that a local jurisdiction can move.

Many of us in the Congress had thought that the better way would be to look at dangerous freight traveling throughout the United States and to try to look at all the options to try to in fact see what could be done. And as far as I can tell, the Railway Administration, the Department of Homeland Security have taken no action whatsoever. This is post-9/11, when everybody is rushing to take action to shore up various modes of transportation. We are talking about the transportation that most people use—rail, and of light rail, subways, and the rest.

Yesterday at the markup of the Homeland Security Authorization, there were two provisions—one was report language, and one was a provision actually added. One had to do with passenger trains, to say, that would require DHS, presumably you to do what can only be called the basics, to take what you have learned, and I know that there is great deal of consultation and work that has

been done with the railroads, and disseminate what best practices should be post-9/11.

And the other was something that of course we have already done with air travel, and that is to take what you know and disseminate it to operators of trains so that they know how to prepare employees and the public to understand what to look for. Now here we are four years after 9/11 and we are asking part of our Government that regulates trains to do these basics.

On freight, there is probably going to be report language on matters like pre-notification, for example, of local jurisdictions when hazardous substances come through. Our own Fire Department here in the District of Columbia, you would think that if you did not notify anybody you would be notifying the EMSes, said, when the council bill was being shepherded through, he did not have a clue as to what was coming through so that he could at least be alerted in case something happened. There may be language on setting protocols for effective communication between the authorities and operators, training for employees so that they know what to do, the kind of training that has taken place with respect to air travel.

I simply would like your response about the inaction of DHS on trains, especially freight and passenger, especially when compared with a great deal of action that has been taken within DHS, TSA, et cetera, with air travel, and especially considering large numbers of people who use rail travel and the extent to which our country is dependent upon the transport of dangerous toxic substances.

No one wants to stop it from happening, but, again, unrebutted testimony that one car right here in the national capital, one car successfully attacked could emit gases that would travel 14 miles throughout the entire region, causing 100,000 deaths within a half hour if the wind is going in the right direction. That is what caused a local jurisdiction to move. And you are going to see, if there is continued Federal inaction, you are going to see people popping up all over the United States saying I am not going to sit here and wait for something to happen.

So I would simply like to take this opportunity to get your response to what has happened here in the District of Columbia, and to ask you what you intend to do to begin to take the kind of action for trains and freight post 9/11 that we have seen in air travel.

Ms. STRANG. Thank you. We are not part of the Department of Homeland Security or the Transportation Security Administration that has the lead in this effort. We are taking numerous steps to make---

Ms. NORTON. Is this the Railway Administration?

Ms. STRANG. This is the Federal Railroad Administration.

Ms. NORTON. Well, the Federal Railroad Administration has a very heavy lead in what I am asking you about.

Ms. STRANG. We do, but it is through the Toxic Inhalation Hazard Project that is managed by the Office of Safety. I will be very happy to get a response for you from them. It is not something that I have expertise in.

[The information received follows:]

ANSWER: By statute and Presidential Directive, the lead responsibility for transportation security rests with the U.S. Department of Homeland Security (DHS). DHS is working with the Department of Transportation (DOT) to prepare a report to Congress, in response to section 4001 of the Intelligence Reform and Terrorism Prevention Act of 2004 (Pub. L. No. 108-458), that will present a National Strategy for Transportation Security and associated modal-specific plans. This report will provide the type of information requested by Delegate Eleanor Holmes Norton and this Subcommittee.

In general, DOT plays a supporting role to DHS on transportation security matters, providing technical assistance and assisting DHS when possible with implementation of its security policies, as allowed by DOT statutory authority and available resources. To facilitate cooperation between the parties, DHS and DOT have entered into a Memorandum of Understanding detailing their respective roles and responsibilities and an Annex dealing with hazardous materials considered toxic inhalation hazards.

Under the leadership of Secretary Mineta, DOT has been very active in helping DHS promote the security of the railroad (both freight and passenger) and transit systems, as outlined below.

Immediately after 9/11 the Administrator of the Federal Railroad Administration (FRA), on behalf of the Secretary of Transportation, conducted an industry-wide teleconference with representatives from all major freight, passenger, commuter, and shortline railroads, all rail labor organizations, and the Federal Transit Administration (FTA) to discuss how the industry should re-examine the issue of railroad security. As a result of the teleconference, six rail industry task forces were formed to re-examine security risks in the railroad industry and develop strategies to deal with those risks. Working closely with DOT and DHS and Federal, State, and local law enforcement and intelligence agencies, the freight railroads developed a comprehensive model security plan that includes the following components:

$ a database of railroad critical assets;
$ assessments of railroad vulnerabilities;
$ an analysis of the terrorism threat;
$ calculations of risk;
$ identifications of countermeasures to reduce risk;
$ a definition of alert levels;
$ a delineation of actions to be taken at each alert level; and
$ a description of the functions of the Association of American Railroads operations center and railroad alert network.

In 2003, FRA and the Amtrak Inspector General contracted with the RAND Corporation to conduct a study of Amtrak=s security plans. A report was issued in July 2004 that encouraged

Amtrak to engage in a strategic security planning process to help ensure the consistency of its security plans with the rapidly evolving terrorism threat situation. The report contained 41 recommendations, including a recommendation that Amtrak start with a rigorous, system-wide assessment of the vulnerabilities and threats that it faces. Since the issuance of the RAND report, Amtrak management has made progress in responding to the findings and recommendations of the report.

FRA, in partnership with FTA, participated in the security risk assessments on the ten largest commuter railroads and contributed the funding for security risk assessments on three of these railroads. FRA also participated in the FTA Abest practices tool kit@ initiative, contributing our knowledge of commuter rail operations, infrastructure, and organization to ensure that the security enhancement measures contained in the plans were sound and feasible in a railroad environment. FRA staff worked closely with many of the railroads that received FTA grant funding, to plan and assist in the development and implementation of security simulations and drills.

FRA, FTA, and TSA have devoted staff with both railroad knowledge and facilitation skills to the FTA-TSA-sponsored workshops across the country (called AConnecting Communities@) to bring together commuter railroads, emergency responders, and State and local government leaders so that they might better coordinate their security plans and emergency response efforts.

TSA and FTA co-sponsor Transit Safety and Security Roundtables, an initiative that provides a mechanism for the transit safety and security chiefs from the Nation=s largest transit systems to share information on technology and best practices useful to securing the Nation=s transit systems. The last of these Roundtables was held on October 16-17, 2003 in Washington, DC, and the next is tentatively scheduled for August 2005 in Houston, TX.

FRA has also partnered with the railroad industry, rail labor, and State and local law enforcement to establish a railroad alert communications network (the Railway Alert Network, or RAN) for the distribution of information and intelligence concerning security issues. The information and intelligence communicated range from general notification of a change in security alert status, to specific threat information concerning a particular segment of the industry or area of the country. There is also the Surface Transportation Information Sharing and Analysis Center (ST-ISAC), whose membership includes the railroad companies, the Association of American Railroads (AAR), and the American Shortline and Regional Railroad Association (ASLRRA). The ST-ISAC provides the security and threat/warning information.

A significant initiative to improve hazardous material security is the development and implementation of DOT=s regulations requiring the development of security plans by railroads and shippers of placarded hazardous materials and training for all shippers and carriers of these materials. Security plans under these regulations are required to be based on a threat assessment and to address commensurate countermeasures in three specific areas--personnel security, unauthorized access, and enroute security. To assist railroads that transport hazardous materials and shippers that offer hazardous material for transport by rail,

particularly small and medium-sized companies, to comply with this new requirement, FRA field personnel have spent a considerable amount of time in outreach efforts. To date, FRA personnel have reviewed almost 2,000 security plans and training programs for more than 8,000 employees.

DOT has also worked with DHS on a coordinated plan to improve the security of the rail transport of hazardous materials classified as toxic inhalation hazards (TIH). In April 2004, the Homeland Security Council tasked DOT and DHS with taking the following seven specific actions to improve the security of TIH shipments by rail:

! assessing vulnerabilities and constructing protection plans;
! developing protocols for protective measures;
! making rail cars less identifiable to terrorists;
! improving compliance with security plans;
! establishing communication standards;
! enhancing the ability of rail cars to withstand attack; and
! improving rail car security during storage.

Improving the security of TIH shipments presents complex challenges because (1) the open infrastructure of rail transportation provides significant opportunity for attack, (2) just-in-time delivery of TIH chemicals is needed to support essential services, such as drinking water purification, and (3) important economic functions, such as silicon chip production and manufacturing, make the use of TIH chemicals unavoidable. DOT and TSA published a notice and request for comments in the Federal Register asking for input on aspects of TIH rail shipments, the DOT security program requirement, and the need for additional regulation. 69 FR 50988 (Aug. 16, 2004). More than 100 comments were received, addressing the following issues:

- security plan improvements;
- shipment identification and hazard communication;
- temporary storage;
- tank car integrity; and
- communication and tracking.

As part of the assessment of vulnerabilities in high-population urban areas where TIH materials are moved by rail, DHS and DOT conducted a pilot project for the DC Rail Corridor. This project is almost complete. To date, DHS and DOT have completed a vulnerability assessment, a buffer zone protection plan, and a freight rail hazard analysis. Based on the results of these assessments, the Federal Government developed a risk mitigation plan and is in the process of awarding a contract to provide additional security enhancements and hardening of the DC Rail Corridor.

The FY 05 DHS Appropriations Bill Conference Report 108-774 earmarked $10 million for TSA to deploy up to 100 Federal rail compliance inspectors. The first class of these inspectors completed training in early June, and the final class will graduate in mid-

October 2005. TSA's goal is to have all inspectors in the field by fall 2005.

DHS has worked closely with the rail operators and industry representatives to help mitigate terrorist threats against the Nation=s passenger and freight rail systems, through the following activities:

! conducting vulnerability assessments of the top U.S. rail transit systems and identifying where they have vulnerabilities that must be shored up;

! working with the Association of American Railroads, the trade association representing all Class I freight rail carriers, on a national vulnerability assessment and security plan for freight rail carriers;

! conducting corporate security reviews for the Class I railroads as well as mass transit system operators;

! providing over $175 million in grants to non-Federal entities (States, localities, regions, transit operators) to enhance their own security measures;

! conducting targeted vulnerability assessments and protection plans in urban rail corridors that may be applied in other major urban areas;

! establishing communication and information sharing procedures between rail and transit operators and the Federal Government;

! issuing Security Directives to provide a security baseline for commuter rail, Amtrak and the Alaska Railroad Corporation; and

! assisting local authorities with National Special Security Events, such as the 2004 Republican Convention and the 2005 Presidential Inauguration.

Ms. NORTON. Mr. Chairman, I just want to say in closing, you see the answer was, duh. When I think Mr. Quinn was Chair of this Subcommittee, the Railway Administration was before us and I sat in on a hearing. This was before South Carolina. And in the process of examining someone like yourself from the Railway Administration, I asked the Chairman if before the end of the year he would agree that the Railway Administration would provide a plan, particularly given the considerable work they had already done, to the Chairman. Then Chairman Quinn went on record and said I want it, and I want it before the end of the year.

And Mr. Chairman, as you take over the chairmanship of this Subcommittee, I want you to know that no such plan has come forward.

I think it is a clear and present danger to our country. And I think, frankly, that what is happening on freight and passenger travel is more of a security risk today than what we might expect on air travel, because we at least have begun to take preventative actions there and we see no consistent preventative action on the part of the Railway Administration and others who should be involved. Thank you very much, Mr. Chairman.

Mr. LATOURETTE. I thank the gentlelady very much. I will check with the staff as to what that status was last year and be happy to follow up with the FRA.

Just a couple of observations. On a personal level, my fear has always been when we create these parallel universes, that is, a Federal Rail Administration and a Department of Homeland Security that seems to be like an octopus, we have several poorly funded agencies all running around in different directions rather than dealing with what I consider, and I know the gentlelady when she was the distinguished Ranking Member of our last Subcommittee assignment, consider an all-hazards approach.

You also get silly regulations, such as the folks that thought up why do we not take off the hazardous material warning labels on tanker cars, so that nobody knows, especially the firefighter who is first on the scene, that he or she is actually there to clean up chlorine, so that we can trick the terrorist. I think that is an example of something stupid. And lastly, I hope that the District of Columbia's action is not replicated across the country. I have difficulty finding out why the judge was able to find it not at odds with the commerce clause, and we can have an honest disagreement about that.

But I think the gentlelady's points are well taken, that we have spent a lot of time making sure that terrorists cannot take over airplanes, we have spent precious little time dealing with train travel in this country.

There is a vote on. Mr. Sodrel, do you think that you have less than five minutes of questions, or should we recess and come back? It is your pleasure.

Mr. SODREL. We are about to vote. I guess I could ask the questions and get answers in writing, if necessary.

Mr. LATOURETTE. If that is suitable with you. And that brings up something Mr. Menendez has asked me to do as well, and that is ask unanimous consent that all members of the Subcommittee have the same 30 days which we had under the previous unani-

mous consent request to submit additional questions to this and the remaining panels, and we would appreciate the answers when you can get them to us. Thank you very much.

That being said, there is a vote on the House floor. We will stand in recess and return immediately after the vote.

[Recess.]

Mr. LATOURETTE. We are going to bring the Subcommittee back into order. The good news is I think this vote we just had on the House floor may be the last for a while. There seems to be a problem with the vote count on the Budget Resolution. So I think we are good to go for not only the rest of this panel, but also the other two panels. So, hopefully, we will not be interrupted.

Before we left, Mr. Sodrel, you were kind enough to say that you might want to submit the questions. But we have held the first panel back, so fire away.

Mr. SODREL. Thank you, Mr. Chairman. You know, in the highway industry we have statistics that we use on accidents. There are accidents, incidents, then there are DOT reportable accidents. DOT reportable would be ones where the vehicle is towed, it cannot be driven away on its own; you have an injury or a fatality. I have heard that the accidents are up, and I have heard that the accidents are down on the railroad.

So my question is, how many deaths do you have per passenger mile traveled on railroads? How does that compare with intercity motorcoach, or air travel, or private automobile, or some other standard where you have deaths per passenger mile? Do we know? And if we do not, if you can get the answer, I would appreciate it.

Ms. STRANG. I think I do. I just need to look to see if I have got it.

Mr. SODREL. I just occurs to me, we kill somewhere north of 40,000 people a year in automobiles. It seems to me that railroad travel

Ms. STRANG. Over the past five years, there have been 22 passenger fatalities. So the rate is very low. But I will have to get back to you with the actual rate per million passenger miles.

[The information received follows:]

ANSWER: I am advised that over the past five years (2000-2004), there have been 20 rail passenger fatalities, not 22. Here is the breakdown:

Year	Number of Rail Passenger Fatalities	Rate of Rail Passenger Fatalities per 100 Million Passenger-Miles
2000	4	0.02478
2001	3	0.01916
2002	7	0.04615
2003	3	0.01924
2004	3	0.01934

With regard to the comparative safety of the different modes of transportation, I would like to make part of the record a chart comparing the number and rate of passenger deaths per 100 million passenger-miles, by mode of transportation. As the chart demonstrates, rail passenger travel is in general much safer than travel by passenger automobile or similar vehicle and is comparable in safety to travel by bus or scheduled airline.

In the latest year for which comparative statistics are shown (2002), there were seven rail passenger deaths, as compared with 20,408 passenger deaths in passenger automobiles and 12,186 passenger deaths in vans, sport utility vehicles (SUVs), and pickup trucks (Asimilar vehicles@). In other words, in 2002, seven rail passenger fatalities occurred, compared to a total of more than 32,000 passenger fatalities in cars and similar vehicles. In 2002 there were also 36 passenger deaths in buses and zero passenger deaths on scheduled airlines. In the same year, the rate of passenger deaths per 100 million passenger-miles was zero for scheduled airline passengers, 0.05 for rail passengers, 0.06 for bus passengers, and 0.77 for passengers in passenger automobiles and similar vehicles.

In the previous year (2001), there were three rail passenger deaths as compared with more than 31,000 passenger deaths in passenger automobiles and similar vehicles. The same year there were 11 bus passenger deaths and 279 scheduled-airline passenger deaths, and the rate of passenger deaths was 0.02 for rail or bus passengers, 0.06 for scheduled-airline passengers, 0.76 for passengers of similar vehicles, and 0.79 for passenger-automobile passengers.

[Insert chart designated FRA Exhibit 6.]

COMPARISON OF PASSENGER DEATHS BY MODE OF TRANSPORTATION[1]

	Passenger Auto		Vans, SUVs, Pickup Trucks		Buses		Railroad		Scheduled Airlines	
Year	**Deaths**	**Rate**	**Deaths**	**Rate**	**Deaths**	**Rate**	**Deaths**	**Rate**	**Deaths**	**Rate**
2000	20,444	0.80	11,435	0.76	3	0.01	4	0.02	87	0.02
2001	20,221	0.79	11,690	0.76	11	0.02	3	0.02	279	0.06
2002	20,408	0.77	12,186	0.77	36	0.06	7	0.05	0	0.00
2000-2002	61,073		35,311		50		14		366	
2003							3	0.02		
2004							3	0.02		

[1]The rate is the number of passenger deaths per 100 million passenger-miles. Railroad passenger deaths include those that occur while person is boarding or leaving train. The source for other modes of transportation is the National Safety Council Injury Facts (2004 edition).

Mr. SODREL. Thank you. Thank you, Mr. Chairman.

Mr. LATOURETTE. I thank you very much. And again, subject to the questions that Mr. Menendez had where you were going to supply some additional information, and also the unanimous consent request we made a little bit earlier, there may be additional questions coming your way from other members of the Subcommittee or from members of the Subcommittee that were here. We would appreciate your timely response.

Also, when Ms. Norton was here, we will follow up at a staff level here on the Subcommittee relative to what Mr. Quinn may have asked of the FRA during the last Congress. But if you could sort of poke around the agency and if you can figure out what it is he was looking for and let us know, we would appreciate that as well.

So we thank you, and you go with our thanks.

It is now time to hear from our second panel. Our second panel is comprised of Mr. Edward Hamberger, who is the President of the Association of American Railroads; Dr. John Samuels, who is the Vice President of Operation Planning Support for Norfolk Southern; and Mr. William Pickett, who is the President of the Brotherhood of Railroad Signalmen. I thank you all for coming. We have received all of your written testimony. If you could summarize your testimony to the best of your ability, we would appreciate that.

Mr. Hamberger, you are on.

TESTIMONY OF EDWARD R. HAMBERGER, PRESIDENT, ASSOCIATION OF AMERICAN RAILROADS; JOHN SAMUELS, VICE PRESIDENT, OPERATION PLANNING SUPPORT, NORFOLK SOUTHERN; WILLIAM D. PICKETT, PRESIDENT, BROTHERHOOD OF RAILROAD SIGNALMEN

Mr. HAMBERGER. Thank you, Mr. Chairman. I appreciate the opportunity to participate in your first hearing as Chairman of the Railroad Subcommittee. And I would like to echo Mr. Oberstar's opening comments, that it is indeed very appropriate that the first hearing focus on railroad safety and security. I would like to make a few brief opening remarks and then transfer my time to Dr. Samuels to go into a little bit more detail on some of the new technologies emerging.

I would like to also thank the Committee for the leadership and vision it has shown during the reauthorization of TEA-21. There is no more vexing safety problem faced by railroads than that posed by grade crossing accidents and trespassers. We would like to thank the Committee for its strong support for increased funding for the Section 130 Grade Crossing Safety Program, and we ask you to continue to demonstrate such support in conference with the Senate.

Nothing is more important to the Nation's freight railroad than the safety of their employees, customers, and the communities in which we operate. That is demonstrated by the scope and intensity of the industry's safety efforts. These efforts have resulted in dramatic improvements in railroad safety.

Since 1980 the train accident rate has been reduced by 65 percent, and the employee casualty rate has declined by 78 percent.

Last year, 2004, in fact was the safest in history in terms of both the number of employee casualties and the employee casualty rate.

Let me try to address Congressman Sodrel's comments and Mr. Oberstar's. Mr. Oberstar is, in fact, correct that the absolute number of accidents has gone up in 2004 over 2003, but the rate of accidents, the rate as measured in million train miles, has gone down slightly. Similarly, while the number of highway-rail incidents has gone up, the incident rate, as measured in terms of million train miles, is the lowest on record, and that rate does not take into account the fact that highway traffic has also been increasing.

We work continuously to improve all aspects of rail safety, including that related to hazardous materials. Railroads move about 1.8 million carloads of hazardous material annually, and 99.998 percent reach their destination without a release due to an accident. Rail hazmat accident rates are down 90 percent since 1980.

We work continuously to assist communities in preparing emergency response plans, we provide emergency training for emergency responders, work with tank car owners, users, and builders to improve tank car safety, and work with rail labor to try to identify ways to improving operating safety.

The source of much of our past success and a critical foundation for future gains is the implementation of new and improved technology. The industry funds an extensive research and testing program centered at the Transportation Technology Center in Pueblo, Colorado, which we operate under contract to the FRA. It is widely considered to be the finest rail research and test facility in the world, and the crash tests that you saw the tapes of from Ms. Strang's testimony were actually performed at Pueblo at TTCI. And I would echo her invitation to this Subcommittee to visit Pueblo either independently or as part of the next crash test in February.

Let me now turn over two minutes and fifty-three seconds to Dr. John Samuels to testify on behalf of the AAR about some of the advances in rail technology. He is senior Vice President, Operations Planning and Support with Norfolk Southern, and just as importantly, serves as Chairman of the industry's Railway Technology Working Committee.

Mr. LATOURETTE. Dr. Samuels, thank you very much for coming. The last time I saw you you gave a presentation that included coefficient of frictions and yaws and things like that. Maybe if you could dumb it down for me today, I would appreciate it very much.

[Laughter.]

Mr. LATOURETTE. But thank you for coming.

Mr. SAMUELS. Thank you, Mr. Chairman. It is a privilege to be here today with you. I would like to talk a little bit about the science behind safety in railroading.

Those of us in the scientific community that have dedicated our lifetime to making railroads safer for everyone appreciate the time we are going to have to talk to you about some of our advanced technologies. Time does not permit me to cover the wide variety of things we are doing, and I echo what Ed said, but I certainly would personally love to be out at TTCI when you and your Committee visit TTCI to be able to take you through all the good things that we are doing in terms of improving railroad safety.

Let me start at the beginning, though, for today. The first slide I want to show you is a slide that shows the wheel-rail interface. You might think it is interesting that I would show this slide. But in my mind this is the most important slide to understand if you want to understand the foundations of safety on railroading.

You can see from this slide, which is a cross-sectional view of a wheel-rail interface, the red area is the wheel, the blue area is the rail. You notice it is labeled "vertical force" and "lateral force." There are two major forces that we must contend with and control in railroading to control the safety of the environment, and that is those two forces. You will see from this slide also that we have above rail programs called Advanced Technology Safety Initiative, ATSI, which is from this interface upward into the railcar, including the wheel set and the suspension system, and then we have a similar set of initiatives from the rail down, which is called Performance Based Track Standards. Today, I am going to give you a view of the most advanced technologies we are working with and the reasons why we are working with those.

I bring to your attention first this cross-section of a piece of rail. What we really have at this interface is this rail in interfacing with the wheel does so, and I am going to put just a dime on the top of the rail surface here. All the stresses generated by the railcar go through an area the size of a dime. And in railroading today the stresses that go through there is 36,000 pounds per wheel set, on average.

So we put the weight of approximately seven large SUVs through that dime into the rail infrastructure. And through the life of the assets, both the wheel and the rail, what we need to do is to control, believe it or not, that contact patch. One of the challenges of engineering science in railroading is to make sure that patch, when it starts out with new wheels and new rails and is the size of a dime, stays the size of a dime. Because if that contact patch varies or gets smaller, the stress goes up exponentially that is transmitted from the wheel to the rail. It is very important to do that.

Now you see this cross-sectional rail. When we wear a rail out the ultimate wear-out rate depends on the strength of the rail and the entire track system. But this is a piece of rail that is at the condemning limit and is worn out. You can see that the geometry of the head is very much different than a brand new piece of rail. In a rail's life between brand new and this condition, we continuously monitor the rail and we look for things that will cause that rail to fail. And I am going to cover some of the latest technologies both from a rail standpoint and a wheel standpoint.

On the next slide I would like to show you what we are trying to prevent. This slide is a picture of a fractured wheel. So let us talk about the wheel up for just a moment. This is a fractured wheel set. This is a real wheel that broke on our railroad. We did a complete metallurgical analysis of this wheel and it turns out in the metallurgical analysis that a small crack initiated at a defect in the casting. This wheel was about 12 years old when this occurred. So these wheels can stay out a great length of time before a crack initiates. There is a whole body of science on crack initiation and growth. In this particular case, the crack over time perpetuated to the point where the stress at the wheel-rail interface

that was transmitted up into the wheel caused the crack to grow to a point where the wheel failed.

One of the sciences we are trying to look at is, and it has been brought to your attention here, that many of these cracks that first initiate and grow cannot be seen by the human eye. And so no matter how hard you inspect these from a human standpoint, you cannot find them. So I want to tell you a little bit about the science we are using to get to the vital few areas where the human being really does not help that much any more and we have to use science.

On the next slide, I portray for you the latest in laser acoustic testing. Now, let us keep it simple, like you said. What we have here is the diagram and in the upper left is a cross-section of a wheel. The little rectangle above it is a laser. It is a similar image on the right-hand side except you can see the little piece of a crack there that is growing at the surface of the wheel. The principle involved here is very simple: if these cracks grow and perpetuate through the wheel and ultimately fail, how can we find the crack before the failure occurs. What we do is we hit the wheel with a laser, the laser creates a mechanical pulse through the wheel.

The image down below on the left shows a very strong return signal to the transducer, which says that the wheel is sound. The image on the right down below shows that the initial pulsing of the wheel with the laser was dispersed, significantly increasing that there is a crack in the wheel. So we are using this technology, which is brand new, by the way, to look at better ways of finding cracks in the wheel.

On the next slide is our demonstration project at TTCI. To impinge the laser on the wheel and then to get the reflected sound, you have to follow the wheel as the railcar rolls by the transducer. So we have actually built a prototype system where we have a carriage that does the laser impingement and follows with the transducers as the wheel rolls over the rail, because we cannot find these things productively and efficiently unless we do it dynamically as the car rolls. And so we are working on this technology.

While we are still speaking about the wheel, let us talk about this patch the size of a dime. If a wheel wears non-uniformly, that patch can get very small at the contact point. Now the picture on the right shows a wheel that is worn to what we call a hollow. That is a natural phenomena, the wheel is softer than the rail. And so in railroading the wheel does prematurely wear out.

But what we need is technologies that will allow us to watch the wheel wear-out and pick the wheel off the car and remove before any accident occurs because of that geometry. The picture in the lower left-hand side shows a hollow wheel riding on a rail. If you look closely, you can notice that when the wheel is hollowed only a piece of the wheel contacts the rail. That creates a contact patch that is about one-quarter of the size of a dime, which increases the stress state of the railroad and can cause potential damage and failure of components.

Now, how do we find hollow wheels? If we put human beings under the rail cars when they are stationary, it is very labor intensive and, quite frankly, in all kinds of weather and conditions it is very difficult to do. We are using new technology here. In the left-

hand picture in this chart you see a bunch of lasers and laser cameras. In the lower right-hand picture with the red diagnostics, you see that what we do is we shine a laser on a wheel on a train going 50 miles an hour over this detector.

The laser image is captured on cameras digitally and we rotate that image in three dimensional space, and within milliseconds we do a complete dimensional check of the wheel while the train is going over the detector at 50 miles an hour. And this development is now being put in place on railroads and will be used to watch wheels as they wear out.

We also have, on the next slide, a train going over what we call a wheel impact detector. This is some transducers in the track that measure the vertical force that the wheel exerts on the track all around its circumference. We can pick out heavy hitting wheels that cause excessive stresses and route those cars to the car shop for wheel removal before they do damage or cause a derailment.

Also on this slide you can see some boxes there in the lower left-hand side. That is an acoustical detector. While we are checking the vertical impact load of the wheel, we can also check whether the bearing is going bad. Right now on the railroad every 20 miles we have an infrared detector that looks at heat for a bearing going bad. Sometimes that is too late. And so what we try and do is find bearings before they fail. This is an acoustical detection system. Here is the frequency which we have correlated to defects in the wheel. And so we will just play one of these to show you what it sounds like.

[Audio presentation.]

Mr. SAMUELS. Now, if you have not heard that lately, that is a cupsball on the wheel. That says that the wheel bearing has a fretted surface that is beginning to fail. We can find through these sounds, believe it or not, bearings that are on their way to failure but nowhere near failing. And so we can take them out of service early.

On the next slide what I am showing you is that we have now put these detectors I have told you about into a network of detectors in the United States. All railroads have a standard detector design. We have deployed these detectors nationwide and we are in the process of gathering all this data and putting it into one computer and accumulating it by rail car, by wheel, by axle.

And so what we have in the next two to three years is we will have a system in place to actually watch rail cars wear out over their lifetime, understand the stresses that they cause at the wheel-rail interface, that contact patch, and control those forces.

Finally, I would just like to talk about one thing above the topper rail. If you look at the wheel rail interface, a lot of the forces that are transmitted, are transmitted on curves. I will show you the worn rail, and this comes from a curve, because the geometry is very different.

We have recently developed top of rail lubrication, which is an inert material that is put on the top of the rail. As you can see on the upper right hand side, you only put a mono-layer of this lubricant on the rail. It changes the coefficient of friction, and Mr. Chairman, you said, I love coefficient of friction, as you know. It

actually has been found to cut the lateral forces on curves by 40 percent. That is being perfected.

The next slide is just some data that shows you that in taking gauge widening on the rail, the actual spreading of the rails, which can cause derailments if it is not controlled, in actually looking at that, we have data over a year's period to show that when you lubricate the top of rail and change the coefficient of friction, we have actually gauge widening that has occurred on a very severe curve and in coal territory in West Virginia.

Then finally, I would just like to say that we are multiplying the scientific effect of these various detectors, by taking what we learn from this laser acoustics in the wheel that I just showed you, and we are looking at rail, as you see here.

Here, this rail has a vertical split or crack in it. A human being inspecting the track could not find this crack. But what we are doing is, we are perfecting that laser acoustics, so we can run down the track and find that accurately, every time. That is just some of the advance science that we are using to improve railroad safety. Thank you very much.

Mr. LATOURETTE. Dr. Samuels, thank you very much, that was a very good use of Mr. Hamberger's two minutes and 54 seconds.

[Laughter.]

Mr. LATOURETTE. Mr. Pickett, thank you for coming, and we look forward to hearing from you.

Mr. PICKETT. Thank you, Mr. Chairman and members of the Committee. It is an honor for me to testify today on new technology and rail safety. It is a subject that is of great concern to this country and to all of our the employees on the Nation's railroads.

Throughout our entire existence, the BRS and other rail unions have dedicated themselves to making the railroad work place safer, not for just rail workers, but also for the public at large.

The rail industry is moving more freight with fewer employees than at any time in the history of railroading. Through mergers and the railroad management's never-ending quest to eliminate workers, railroad staffing levels are at an all-time low, and in some crafts, the numbers continue to drop.

Those railroad employees that are left are working longer hours, and for many days at a long stretch at a time. A 12 to 16 hour day is not unusual for a railroad worker, and in many cases, it is the norm.

On March 7th of this year, the Federal Railroad Administration issued the Final Rule for the Development and Use of Processor-Based Signal and Train Control Systems. With this Final Rule, FRA is issuing a performance standard for the development and use of processor-based signal and train control systems. The rule also covers system which interact with highway-rail grade crossing warning devices.

I want to say personally that this change is a great step in rail technology. Signal systems currently in use today are designed to protect the safety and integrity of the railroad's operations on a section of track that provides for broken rail protection, track defects, track obstructions, proper switch and derail alignment protection, route integrity protection, and protection against train collisions.

Signal systems are designed to mitigate the dangers caused by human error and acts of vandalism or terrorism. Clearly, it is in the best interest of the railroad and the local residents to have the protection of a signal system.

A good example of the benefits of a signal system can be seen when we look back to January 6th of this year. The derailment that many of us have talked about today happened in Graniteville, South Carolina, which the preliminary investigation has indicated was a result of an improperly aligned switch. Nine people died, 318 needed medical attention, and 5,400 residents within a one mile radius of the crash site were forced to evacuate.

The segment of the track where the accident occurred was called Dark Territory. A basic signal system would have prevented this accident. A switch monitoring device would have noted that the hand throw switch was not properly aligned, and the train would have had a stop signal.

The BRS does not believe that improper planning by the railroads and their failure to properly maintain a signal system can be reasons for the FRA to grant a waiver request to increase the amount of non-signal territory in our Nation's railroads.

Positive train control systems are just one facet of the signaling revolution that is occurring. Many current signal systems benefit from the changing technology. We must work to ensure that any new technology that the railroad industry contemplates to implement, that the proper risk analyst and proper steps are taken to make sure that the new devices introduced do not create more new hazards than we eliminate.

The rail unions consider it equally important to provide advanced training and education to improve the skills of the professional men and woman that install the safety devices on our rail systems.

In addition to craft-specific training, security training must be mandated. While some rail carriers might claim progress in this area, I have talked to too many workers who are not receiving any training, or might be allowed to watch some video that tries to be a one-size-fits all.

The railroads transport the most toxic and dangerous materials in the country. Most every freight train in the United States transports some types of hazardous material. The train crews are given very limited training in understanding what to do in case of a hazardous material leak or explosion.

After 9/11, each railroad was required to develop and implement security plans. The Transportation Security Administration has apparently approved most of the plans on the railroads. The problem is that the employees have never been brought into the loop.

The bottom line is that the TSA and the railroads must promptly begin an intense training program to educate and prepare railroad employees to recognize potential terrorist and safety security risks.

In addition to training, we must also ensure that workers who report and identify a security risk will not face retribution or retaliation from their employers. A rail worker should not have to choose between doing the right thing on security and his or her job.

If Congress considers rail security legislation, it must address this problem, by strengthening the current whistle blower protections. Over three and-a-half years have passed since 9/11, yet

amazingly little has been done to secure our Nation's transportation network, especially in rail.

Sufficient resources have not been allocated. Common sense requirements have not been imposed. Too often, employees and their unions have never been enlisted in the process. Amtrak alone requires $110 million in one-time security upgrades.

One way that we can improve the infrastructure inspection is to direct the Secretary to issue rules requiring that no visual track inspection be conducted from a vehicle traveling at a speed of more than 15 miles per hour.

The incorporation of a nationwide telephone notification system would greatly improve safety for our Nation's grade crossing signal system. This Nationwide telephone notification system could also be used by anyone to report derailments or other events that affect safety and security on the property.

The Transportation Security Administration is spending $4 billion this year on aviation security, an investment that we, of course, support. But passenger rail and transit are being left with just $10 million for their security.

There are over 100,000 miles of rail in the United States, and 22,000 miles of it are used by Amtrak in 46 states and the District of Columbia. New technology will not cure all that is wrong in the rail industry. There is much to accomplish to make the Nation's railroads safer for communities across the country and for our rail employees.

Experience teaches us that it is Congress that must provide the leadership to make safety a reality. I hope we can work with you in seeing that the improved safety practices become a reality. Thank you, Mr. Chairman.

Mr. LATOURETTE. I thank you very much, Mr. Pickett. Your last observations, I certainly share, and I suspect most of the folks on the Subcommittee share. It occurs to me that we sort of respond to something that happens. We spent a lot of money making sure that terrorists cannot hijack planes. But once we harden targets, they begin to look at other areas. I think you are right to alert us to the issue of railroad security.

Dr. Samuels, I mentioned at the outset of this hearing, on May 11th, we are going to be looking at what happened with the Acela train and the disks that are under some scrutiny today. Bombardier will be here and others to talk a little bit about what is going on.

You talked about the new technology focusing on not only deficiencies or rails wearing out, but you also mentioned that the wheels are softer than the rails. So you are watching wheels as they wear out. Is there a rule of thumb, life expectancies for wheels on a rail car, or is it all different?

Mr. SAMUELS. It depends on a lot of different things, obviously. But it is the percent of time that the car is loaded. It is the number of miles that the car has. So it basically is in miles more than it is in years. Depending upon the load empty ratio, you can get a wheel that goes for 250,000, or you could get a wheel that goes for a half a million miles.

The life expectancy normally on wheels is very long though, in the time frame of 8 to 15 years. The rail that I showed you here

on tangent track could last 40 years, and on curves, it is anywhere from 6 to 12 years.

So these assets have very long lives, and that is why it is critical that we develop these dynamic monitoring systems to make sure we understand the stresses that the car is imparting on the rail, and know the condition of the rails, so that we can put the appropriate amount of maintenance money into both the rolling stock and the rail infrastructure, to keep that contact patch at the size of a dime.

Mr. LATOURETTE. These monitoring devices that you have outlined for us as part of the new technology, I saw the map of the United States. Is there a spacing that they are going to be every 100 miles, every 1,000 miles? How do you figure out where they go?

Mr. SAMUELS. What we have done is this. I will take Norfolk out as an example. We have done a complete analysis of the ton miles on all of our routes, and where cars flow. We have looked at the origin destination pairs. We are locating these detectors to pick up the majority of cars that transit our system.

In other words, what we are trying to do is make sure that we get the maximum amount of cars over these detectors. Now these detectors are not inexpensive. When you install these detectors, you are talking about at least a half a million to one million dollars per detector.

They are detectors that are meant to find defects before they occur; in fact, so far before they occur, that the science we are imparting on this is that we are going to find the defect with this detector network. In other words, we are going to track the car and watch a defect grow. Then we are going to take the car out of service way before that defect ever becomes a safety problem.

It is being integrated now. Each railroad is integrating that advance data into their data systems that will automatically route the cars to a car shop. This is going to happen way before you have an incident with that defect.

Mr. LATOURETTE. You mentioned that the laser technology is new and you showed us a picture of a split rail. I thought I understood you to say that you are testing it so that it is 100 percent and you always find the split that you cannot find by visual inspection. Is that still in the testing phase, or have you ruled that out?

Mr. SAMUELS. No, it is still very much in the testing phase. I do not want to give you the impression that we do not ultrasonically test the rails today. We do. It is a very slow process.

We have cars called generically Sperry cars, which the name comes from the original company that started ultrasonic testing. But we test the main line rails at least once or twice a year. We have the mathematics to look at the number of defects we find. If we find a lot of defects in a given stretch of rail, we come back sooner to test that again.

So the testing frequency depends upon what you are continuously finding. In that way, we continuously hone in on those parts of the rail infrastructure that need to be changed out.

Mr. LATOURETTE. Thank you, Mr. Samuels.

Mr. Pickett, I asked the woman from the FRA a little bit about this portion of your testimony where you talk about cars traveling no greater than 15 miles an hour for the inspection of tracks. I

would just ask you how it is that you arrived at that as being the safe speed?

Mr. PICKETT. The Brotherhood of Maintenance of Way is the one who proposed that. That is one of the other unions that I am here testifying on their behalf, also. But one of the things that we are seeing is the visual testing, not the testing of where the electronic devices are used. They normally are used at 30 miles per hour.

Mr. LATOURETTE. I also read recently that in India, the Indian rail has a signalmen's college. I would ask you, you mentioned training. I think you indicated that you did not think some of the training, and particularly security training, was where you and your membership thought it would be.

Can you discuss a little bit with us how signalmen are trained in the United States, and if there is a technical school where they go to, to learn the trade that they are to embark on? How does a signalman get his or her training in the United States today?

Mr. PICKETT. Most training on the Class 1 railroads are done on the property. They have their own signal schools set up on each individual property.

The requirements to become a signalman got more and more stringent because of the technology. A lot of the railroads are asking for some background in electronics, or at least an Associate's Degree in electronics.

But then that becomes a problem, because initially, our people work out on the construction gangs. That means travel, and a lot of people that are in technical are not willing to do that.

But the training goes from Associate training, and on most of the railroads, some of the Class 1s have what they call advanced signal training, that the signal people go return to.

Mr. LATOURETTE. That leads to a follow-up. I think it was yesterday, the full Committee marked up RIDE-21, which makes available $60 billion over the life of the bill for new rail infrastructure, and hopefully can help with some of the capacity problems we have in the United States, as well as looking at high speed rail opportunities.

Do you feel that there is a sufficient reservoir of qualified rail work force to take us into this next century, or do we need to do more?

Mr. PICKETT. No, I feel that we are going in the wrong direction for qualified people, especially with the next few generations. There are a lot of retirements being faced in the next 10 years. The hiring is going down in a lot of the crafts, rather than up in the crafts for the people to get qualified.

Mr. LATOURETTE. I know in Ohio, we have an electric company that is called First Energy. They come in and they indicate that the average age of their electricians and linemen is about 55 or 56 years of age. Do you know what the average age of your membership is?

Mr. PICKETT. Our average age is 44 and one half.

Mr. LATOURETTE. Okay, thank you very much.

Mr. Menendez?

Mr. MENENDEZ. Thank you, Mr. Chairman, and I want to thank the witnesses.

Mr. Hamberger, I want to ask you this. I heard what you said, but I do not understand how we reconcile what you said with the number of accidents that have gathered national attention, from a series of Union Pacific accidents in Texas, to the BNSF accidents in California, to the deadly accident involving Norfolk Southern's train in Graniteville, South Carolina.

How do you reconcile your assertion? I heard about track mileage and all that. But I am looking at actual hard numbers of accidents. So how do you reconcile your assertion that rail safety is improving, when the FRA data shows an increase in accidents, if you look at from 2002 to 2004, of 380 more accidents?

Mr. HAMBERGER. Yes, Mr. Menendez, thank you for that opportunity to clarify. I have that data in front of me, as well. The point I was trying to make in my opening statement was that the number of accidents has indeed increased, as you so indicate.

But the rate of accidents, I think, is perhaps a better measure of whether or not safety is improving or not improving. That is, the more train miles you have moving, from a statistical standpoint, there are going to be some accidents that, when measured to page two of the data, indicate that when measured as a percentage or the number of accidents per million train miles that the rate, we should probably say it is about the same.

It is 4.03 accidents per million train miles in 2003 and 4.01 per million train miles in 2004. So I think it is that rate that really indicates whether or not safety is increasing, rather than the actual number.

Mr. MENENDEZ. I appreciate that categorization of it. When we look at accidents by car in this country, we look at the total number of accidents, period. We make judgments as to whether we are moving towards greater success or failure by the virtue of the number of accidents that we have.

I heard one of our colleagues suggest that comparison of your success rate in the industry and accidents versus that of automobiles. I am not quite sure that that is a fair comparison, considering not only volume, but also the fact that we use multiple lanes and a variety of other factors that go into car traffic. It does not seem to me like we compare apples and apples in that case.

I know that the industry wants to do this, because obviously, it costs it money, consequences, and reputation and all of that. So I assume that there are good efforts, in addition to all the technology things that are being done. But I hope we deal with the work force side, as well, to help you, as an industry, achieve what should be some mutual goals.

Let me ask you specifically, the title of the hearing is also about rail security. In that context, what has the rail industry done specifically to improve security, and what have you done to work with the workers in terms of rail security training? How do you get your rail security alerts, as an industry?

Mr. HAMBERGER. Again, thank you for the opportunity. It is a bit of a rambling answer coming, I am afraid. We began in September of 2001, immediately after the 9/11 incidents, recognizing that the material that we haul is, in fact, hazardous.

So we quickly put together five different critical action teams that take a look at all aspects of the operations of the railroad, focusing one of those on the transportation of hazardous materials.

We realized very quickly, that we needed help in this regard, and we contracted with a local group called EWA, comprised primarily of former military and civilian intelligence officers. They came in and worked with us to take a look at the rail network the way they were trained, and the way they thought that a terrorists would look at the network.

They brought with them best practices from the intelligence community. In December of 2001, we came up with four levels of alert, prior to Secretary Ridge coming up with his five. We identified and implemented immediately about 50 different ways of operating.

For example, leading up to that point, we had been trying to make our operations more transparent for our customers. We let them dial in and find out where their shipment is. We realized that that was not very secure, and that anyone had access to that information. So we cut back and made that much more difficult for those who do not have the right to know, to try to tap into that.

Then at each level of alert, we have a very specific set of actions that we will take; for example, posting guards at fuel depots. We have reached out and are working with local police forces, the National Guard. When we went into Iraq, the National Guard helped protect and guard about 17 bridges around the country.

We are the only industry that I am aware of that on our nickel has somebody sitting, a badge to sit, 24/7, at the National Joint Terrorism Task Force Intelligence Desk at the FBI, as well as at the intelligence desks out here in Herndon, that TSA and DHS run.

These are people under contract to us. They are at top secret level, and they are sitting there, hoping to help the intelligence community interpret data that they pick up, the so-called chatter. It also is a two-way street.

Mr. MENENDEZ. So primarily, it is informational.

Mr. HAMBERGER. It is based on intelligence.

Mr. MENENDEZ. It is reactive to a potential incident.

Mr. HAMBERGER. It is based on intelligence. That is correct.

Mr. MENENDEZ. But it is not proactive in the context that you have done certain hardening?

Mr. HAMBERGER. No, that is not correct. We have certainly done that, as well. For example, we have made it much more difficult to approach the yards. I get e-mails every day, rail fans around America, saying, you know, you are not letting me take pictures of trains. That is what I like to do.

So that is something we have also been proactive in. Certainly, here in D.C., working with the Capitol Police, working with the D.C. police, working TSA, CSX has spent millions of dollars on intrusion detection devices and other high tech applications to make this particular corridor much harder and a hardened asset.

Mr. MENENDEZ. If I may, Mr. Chairman, very briefly, Mr. Pickett, rail security as it is viewed from rail workers, what do you think needs to be done?

Mr. PICKETT. They need to be trained. I mean, a lot of the stuff that Mr. Hamberger talked about, it is the first I have heard about it. I did not know they had any type of thing. Most of the workers

in the rail industry will tell you the same thing; that they are not aware of any type of training that is going on for the security.

Mr. MENENDEZ. These are the people who are obviously out there in the system.

Mr. PICKETT. They are out on the property every day.

Mr. MENENDEZ. Why do you not do that, Mr. Hamberger?

Mr. HAMBERGER. Well, I guess I would disagree, respectfully, with that characterization. The individual companies, in fact, have made security part of the daily safety briefing. There have been briefings on what to look for, for the operators of the locomotive. If they see anything unusual, they are to report that back to the dispatch center, back to the train master. They are not punished for doing that.

As far as the fact of the hazardous materials that we handle, there have been years and years of training as to how to respond to that. You do not want the operator of the locomotive to get out and be the emergency responder. You want the team that is trained to be the emergency responder to be the first on the scene to know how to handle and respond to some HAZMAT spill. So I guess I respectfully disagree with that.

Mr. MENENDEZ. Well, I have some additional questions, and I do not want to belabor the time. I do have one for Dr. Samuels. I have two quick ones. Is it a helium or neon laser that you are using, or some other form of laser?

Mr. SAMUELS. No, I do not know the exact power source generation of the laser that we are using.

Mr. MENENDEZ. If you could let us know, I would like a verification of it.

Mr. SAMUELS. Okay, I will do that.

[The information received follows:]

Dr. Samuels: Congressman Menendez the type of laser that is used in the detection device I mentioned is a Class IV 800 mili-joules light yang laser.

Mr. MENENDEZ. Lastly, is there any technology that you are using, since we talked about rail safety, in your ambient of what you are doing for the association as it relates to rail security, that you are providing or studying right now?

Mr. SAMUELS. There is a lot of work going on in looking at technological scans on what could possibly be used in terms of rail security.

What we have done, and I echo what Ed Hamberger said, we have had tried to educate our people as to how to be alert and what to be alert for.

We have a lot of eyes. In the case of Norfolk Southern, there are 28,000 people out there every day working. That is a lot of eyes watching the railroad and watching what goes on.

So what we have tried to do is set up police emergency numbers, police emergency desks. There are calls on safety and security among our management team. I have personally been trained in security matters. I went to this terrorism training because I was deemed to be too nice a guy, and did not know how terrorists think.

In formulating our plans on the railroad and our educational processes, what we have tried to do is say, how much prevention can we put in place by educating our people? There are not 28,000

policemen. But there are 28,000 people watching what goes on, and we have a mechanism to report what they see.

There are a couple of specific technologies, if I might, Mr. Menendez. We are working on one that would be a database that would have within it the profile of all 1.5 million rail cars operating on the system.

As the rail car would go by, it would match, through visual imaging, and do not ask me what that means. As the car goes by, it would match the visual image of the car with what is in the database, to see whether or not, for example, a bomb has been planted in the bottom of that rail car. That is something that is being tested out in TTCI.

In addition, as Ms. Strang mentioned, there is research going on for some sort of a liquid armor, that looks as though it actually has self-sealing capabilities, if a breach did occur. This obviously would have not only security, but safety implications, as well. That research is being done at TTCI with DHS funding.

Mr. MENENDEZ. Thank you.

Mr. LATOURETTE. I thank you, Mr. Menendez. I have just one quick follow-up question, Mr. Hamberger. I was surprised when Ms. Norton was here, on this issue about the D.C. legislation that is now in litigation. She opined that the fire chief from the District did not have advance information of what kind of traffic was going through his town.

I understand from my fire chiefs that there is, in fact, technology and a program. I do not know if they subscribe to it or somebody gives it to them free. But my fire chiefs in Ohio indicate to me that they know when a train is coming through town that has chlorine or some other substance, that maybe they have got to perk up about. Am I wrong?

Mr. HAMBERGER. I think Mr. Collins probably should respond, and the next panel can get into some more of the specifics. Let me tell you what I think I know. That is that we do not provide pre-notification on a train-by-train basis.

What we have agreed, and I will double check on this during the break, it is our understanding that the fire chief has been briefed, probably perhaps subsequent to his conversation with Delegate Norton. But we believe that we have briefed the D.C. fire chief.

I met this morning actually with a representative from the International Association of Fire Fighters, who concurs with our view, that with 1.8 million carloads of hazardous material moving around the country, that most fire departments could not deal with the blizzard of information. It would just overwhelm them and become so commonplace that it would not, in fact, perk their ears up.

Therefore, what we have offered, as an industry, is that we would sit down with the appropriate emergency responders in a community, to let them know what are the kinds of things that come through their community, so that they can be trained on those specific hazardous materials. But the pre-notification is not on a train-by-train, car-by-car basis, because of the overwhelming nature of it.

Mr. LATOURETTE. I thank you for that. The other comment I would make is this. It is apparent from the questions by Mr. Menendez and your conversation, Mr. Pickett, that there is a dis-

connect between the organizations that represent railroad employees and the railroads, at least as represented by you today, about whether or not there has been security training.

I often find it to be more instructive, rather than for us to have more hearings and find this out; maybe you could initiate a conversation with Mr. Pickett and his fellow folks.

Mr. HAMBERGER. We have worked well together on other issues, and I am sure we will reach out and talk on this one, as well.

Mr. LATOURETTE. Well, I appreciate that very much. Is there anything else?

Mr. HAMBERGER. If I might, just for the record, thank you for your indulgence in letting us go a little bit longer in the presentations.

Mr. LATOURETTE. I did not even notice. Thank you for coming.

Mr. HAMBERGER. Thank you.

Mr. LATOURETTE. Our third and final panel today consists of three witnesses. First will be Mr. Daniel Collins, who is the President of the Operation Respond Institute. Second will be Mr. Thomas Rader, who is the President of the Colorado Railcar Manufacturing Company; and lastly, Mr. Jeremy Hill, who is the Senior Vice President of the Union Switch and Signal Company.

I want to thank you all for coming. Thank you for your patience as we got through our other two panels. We are anxious to hear from you, and we will begin with you, Mr. Collins.

STATEMENTS OF DANIEL M. COLLINS, PRESIDENT, OPERATION RESPOND INSTITUTE, ACCOMPANIED BY JAMES BOONE, VICE PRESIDENT, AND GERALD LYNCH, EXECUTIVE DIRECTOR OF REGIONAL INFORMATION SHARING SYSTEM; THOMAS RADER, PRESIDENT, COLORADO RAILCAR MANUFACTURING; JEREMY HILL, SENIOR VICE PRESIDENT, UNION SWITCH AND SIGNAL COMPANY

Mr. COLLINS. Thank you, Mr. Chairman. On behalf of the carriers and emergency responders that support Operation Respond, in partnership with the Federal agencies, I am honored to provide the following testimony on new technologies for railroad safety and security.

Accompanying me here today is Dr. James Boone, our Vice President, and also Mr. Gerald Lynch, the Executive Director of the Regional Information Sharing System, one of our strong law enforcement partners.

Mr. Chairman, I would like to express the gratitude of the Operation Respond Team for inviting us to participate in this hearing. I would also like to acknowledge your acceptance to serve on the Operation Respond International Steering Committee, along with your esteemed colleague, the Honorable Nick J. Rahall.

Operation Respond has been involved in developing software products for first responders since 1995. We could not have accomplished all that we have without the assistance of the fire chiefs, the fire fighters, the National Volunteer Fire Council, the chiefs of police, and the International Union of Police Associations.

These response agencies, the Association of American Railroads, and the American Public Transportation Association have been

there for us, time and time again, to fine tune our products, and assist with dissemination and training.

Our software, Operation Response Emergency Information System, is currently deployed in over 26,000 emergency response agencies in the United States, Canada, and Mexico, reaching an estimated one million responders.

The largest component of these installations is the RISS-NET system. Mr. Lynch's organization thought so highly of the OREIS software, that they placed it right next to the Amber Alert System, inside of RISS.

The software OREIS provides a direct link to the software user and the manifests of participating railroads. Responders can obtain verification of hazardous materials contents of leaking rail cars in less than one minute. Our goal is to make sure the first responder is not the first victim.

All Class 1 railroads in the United States and Canada have signed license agreements with Operation Respond. Also, many regional and short line railroads participate, such as the Alaska Railroad and Montana Rail Link.

Basically, Mr. Chairman, the freight railroads have stepped up to the plate. They provide, through our secure software, all the information they have on chemical contents to responders along their routes.

If I may, Mr. Chairman, deviate here a second, this is not pre-information that is supplied. This is live information that is gained by the responder accessing the software, if and when something happens. It is an exception based system that is generated by a query by the responding agency that has our software.

Now, Mr. Chairman, to address the topics specifically mentioned in your letter requesting this testimony, we are going to address three issues. On improved infrastructure technologies, we believe responders to rail transportation incidents often need help to confirm the exact incident location and how best to reach it.

Railroad infrastructure landmarks are not always understood by responders, and have led to responders wasting valuable time finding trains. For example, a railroad milepost may not be directly related to a mile marker located along a nearby highway.

Operation Respond has found that a searchable database of railroad features, designed to overlay on aerial and satellite imagery and street maps, enables emergency responders to quickly and reliably reach an incident site.

In fact, in 2004, under sponsorship from the Department of Homeland Security, Operation Respond developed such a system, an enhanced GIS and overlaid imagery system for the Department of Homeland Security and Amtrak police. The project was a highly focused effort along the Northeast Corridor, and it was completed prior to both the Republican and Democratic conventions.

Operation Respond believes that a cooperative effort with some Federal funding can identify and develop a standardized geospatial database of essential railroad features. The benefits would include allowing carriers to determine the appropriate response organizations in an emergency; assisting railroad police and emergency operations desks to communicate with public agency dispatchers; and

last, to help those responders locate trains in distress in a timely fashion.

The other issue is better emergency planning. Our approach has been to improve emergency planning by bridging the gap between the responders and the carriers. Through easy-to-use software, complicated railroad data is simplified. So a 19 year old volunteer fire fighter can quickly and easily obtain what they need.

Also, I would like to introduce new technology that we have been working on. Our goal is to turn the Operation Respond user base, now 26,000 strong and growing, into a transportation incident alert and messaging system. What we are working on with the AAR and the individual carriers is the capability that sends alerts and messages to those responders and to the carriers' 24/7 operations desks.

These alerts or messages could be directly associated with incidents or based on a potential threat, such as an explosive device or a possible terrorist action.

Last is modern passenger coach technologies. Law enforcement has been particularly interested in Operation Respond passenger coach software. This component of OREIS features passenger car and locomotive schematics, highlighting emergency information, such as emergency windows and doors.

The law enforcement component views these schematics as a very effective tool for dealing with on-board incidents. These could range from identifying locations for hiding bombs and how to approach an on-board hostage situation.

To conclude, Mr. Chairman, I have four recommendations. Number one, all railroads should participate in Operation Respond. I respectively request that this should be a voluntary initiative.

Second, a national railroad infrastructure search engine should be developed. The priority should be DOD routes, hazardous material routes, AMTRAK, and commuter train routes.

Third, a national transportation incident alert and messaging system needs to be developed. Operation Respond software users are the ideal group to serve as the network foundation.

Finally, while the OREIS software deployments are indeed growing, the goal needs to be universal coverage. At the present time, we are essentially half the way there.

Thank you again, Mr. Chairman, and when the questions are ready, we will try to answer them.

Mr. LATOURETTE. Thank you very much, Mr. Collins. Mr. Rader, welcome, and we look forward to hearing from you.

Mr. RADER. Thank you, Mr. Chairman, I am here on behalf of Colorado Railcar Manufacturing to talk a minute about emerging technologies in passenger equipment.

We really have two emerging technologies to talk about. One is the development of double-decker vehicles. The second is the development of the U.S. DMU. I am going to focus primarily on the U.S. DMU.

DMU stands for Diesel Multiple Unit. It simply means a car which is self-propelled and has diesel engines underneath it. It does not require a locomotive, and is capable of being hooked together in multiple units to make various sizes and types of train sets.

They are very common in Europe. There are thousands of them operating throughout the world. It is a technology, however, that has not been in the United States since the late 1960s.

The reasons are multiple, but one of the chief reasons, as Joe Strang presented earlier, in 1999, there were new regulations enacted that required stronger, safer passenger cars.

On the other hand, there were no large orders, no transit agency wanted to order a speculative order of a new self-propelled car that had not been run anywhere.

My company decided that there was an opportunity here to make a United States car that met United States regulations. We went to the Federal Railroad Administration. We got wonderful cooperation. We spent a year and a half working with them, and the result was a U.S. DMU.

Why are we so interested in this? It is very simple. The U.S. DMU uses 50 percent less fuel per passenger mile than a locomotive-hauled train when it is being used in an appropriate service. That is energy security. We are talking about trains using millions upon millions less gallons of fuel per year.

Because we have a lighter train, but still build to the regulatory safety standards, we can use less fuel and we can use more modern engines. So we produce 68 percent less pollutants or emissions per passenger mile. So instantly, we can reduce the emissions from trains.

Because of the noise design and the size of the engine, we actually produce 75 percent less noise. So these benefits are very real when it comes to security and safety.

But interestingly, they do not typically cost millions of dollars more. In point of fact, the operational cost savings from a U.S. DMU, over the 30 year life of the car, is two to three times the value of the car. So a $10 million train set, over 30 years, will save as much as $35 million in operating costs.

They are redundant systems. Unlike a locomotive that has one large engine, they have two or more per train set. So they are not blocking the track when you have an engine failure; and if someone is capable of messing up, if you please, a system, we can still get it off the track and get it home safely.

Lastly, in spite of all these other savings, it has another great benefit in savings in infrastructure costs. We can reduce infrastructure costs because we have shorter trains, so we need shorter platforms. We have fewer cars because they are double deck, so we need fewer maintenance bays and we need fewer parking tracks. So all of these benefits come without any increase in capital cost.

Thanks to the hard work of a member of your Committee, this double deck car development is now in production, and will be in operation in Florida, starting in the middle of July. It is presently in completion, and will be going to TTCI for testing in the whole month of June.

We invite you to come see it. It is a real opportunity for us to maintain the safety level, the only self-propelled vehicle in the world that meets United States' standards.

When you saw those crash pictures, I think it is very important to understand, the first cars you saw do not meet the current

standards. Only the reinforced car met the current standards. These cars meet the current standards.

When it is finally delivered, it will look like this, on the next to the last one there. I want to thank you very much for the opportunity to testify before the Committee.

Mr. LATOURETTE. Mr. Radar, thank you very much for coming. We would like to identify the hard working members of our Committee. So is that Mr. Mica you were talking about?

[Laughter.]

Mr. LATOURETTE. Mr. Hill, thank you for coming, and we look forward to your testimony.

Mr. HILL. Thank you, Mr. Chairman. Chairman LaTourette, Ranking Member Menendez, and Committee members, thank you for the opportunity to present information on technologies that are available today for increasing safety, security, and efficiency of railroad operations.

Our company is part of Ansaldo Signal and the Finmeccanica group of companies. As Union Switch and Signal, we have served the rail industry in the control system business as a leader in the development and deployment of technology throughout our 125 year history.

Development of new products for rail safety and security is a primary focus of the Finmeccanica family of companies throughout the world. We are headquartered in Pittsburgh, Pennsylvania, with manufacturing facilities for our products in Batesburg, South Carolina, and have many representative offices throughout North America. We currently employ about 900 people within the United States.

The rail safety solutions that I am presenting today are currently available in our portfolio. They do provide improved infrastructure inspection and security, positive train control, and better operational planning and emergency coordination.

Let me first discuss our railroad track integrity system. This system, which is based on a proven technology already in service in North America, checks track integrity. That is a broken or missing rail in dark or unsignaled territory.

It can incorporate switch point position detection, and provide communication directly to a train or to a centralized management center.

Many secondary lines are not equipped with train control systems, as we have already heard. There are, in fact, 68,000 miles of Dark Territory in North America. Signal systems not only control the flow of rail traffic, but they can also warn an approaching train of a broken rail or improperly aligned switch. Unfortunately, signal systems tend to be expensive and, therefore, generally uneconomical on light density rail lines.

At Union Switch, we have developed this new implementation, which has the potential to dramatically improve security and safety on these light density rail lines. The system is relatively low cost, and could prevent a reoccurrence of accidents, such as the tragic derailment in Graniteville, South Carolina, earlier this year.

The second topic is positive train control. This system also utilizes proven Union switch technology, which will be deployed on the Alaska railroad for revenue service by summer of the year

2007. Deployment will improve operational efficiency, and prevent train-to-train collisions through the use of GPS tracking and location determination, and on-train operator enforcement.

In our terminology, this system is vital. That is, any system failure automatically results in an overall known safe state.

The third technology is the advanced speed enforcement system. This system provides an improved level of safety. It ensures that trains actually stop at red signals. The system has been implemented on Amtrak in the Northeast Corridor, and also on New Jersey transit commuter operations.

This technology, originally introduced in Scandinavia by one of our Ansaldo Signal sister companies, can be implemented in any territory, and is ideally suited to mixed traffic operations.

We are also exploring a new technology called the Common Operational Picture. Currently, railroad operations planners in cities like Chicago and New Orleans plan inter-line operations the same way they did when railroads were introduced, basically with paper, telephones, and faxes.

Our Common Operational Picture would enable these personnel to see on a geographically-oriented overview, all train operations in these heavily-trafficked, congested areas. The end result will be better planning, coordination, and a reduction in the transit time of the Nation's freight in heavily congested areas.

We are also working on an optimization traffic planner. As you are aware, there areas in the Nation where railroads are already at full capacity. Without the need for adding additional infrastructure, this software-based tool plans overall train operations in real time, taking operational information on the railroad, such as track outages or defective equipment into consideration, to provide the most optimum train plan possible, based on established business objectives; for example, maximizing overall railroad velocity.

The system has been in development at Union Switch for five years, and although not currently deployed on any railroad, the technology has been demonstrated, and we are anticipating deployment on a Class 1 railroad in the near future.

Our civil advisor system was originally conceived for use by 911 emergency responder dispatchers. The system provides secure real-time train information and location on a geographical information system map. Train locations are displayed, relative to detailed highway and street information and other physical infrastructure; for example, public buildings, hospitals, stadiums, et cetera.

Most importantly, the system can provide information on blocked highway crossings, and in the event of a railroad emergency, it can provide additional information, such as train manifest information, HAZMAT detail, and the correct emergency responder contact information. The potential users are enormous: 911 dispatchers, police, railroad and transit agencies, Department of Defense, Homeland Security and Transportation, the Federal Emergency Management, the Federal Railroad and Transportation Security Administrations, to name a few.

We look forward to the further implementation and deployment of these technologies, and encourage your Committee to enact the legislation necessary to establish the innovative public/private partnerships, such as the Create Project in Chicago, that will provide

a mechanism for immediate implementation for the benefit of the rail industry and the public at large.

As always, one of the biggest challenges in deploying new safety technology on rail systems continues to be funding. Before I conclude, I would request permission for the document I have submitted, detailing these new technologies to be included in the record.

Mr. LATOURETTE. Without objection.

Mr. HILL. Once again, I would thank the Committee for the opportunity to present today on behalf of Union Switch and Signal and the railroad's signal and control systems supply community. Thank you very much for your time and support. I would be happy to answer questions that you may have, thank you.

Mr. LATOURETTE. Mr. Hill, thank you very much for your testimony. I am sure both Mr. Menendez and I will have questions.

Mr. Rader, my first question would be to you. How fast do your trains go?

Mr. RADER. The initial train that we have designed is 110 miles an hour.

Mr. LATOURETTE. It is my understanding that aside from the good work that is going on in Florida, that you have also introduced, or plan to introduce, or started to introduce, a new fleet of cars up in the Alaskan railways. Is that right?

Mr. RADER. That is correct. They were just delivered. I got a call yesterday in route to this meeting.

Mr. LATOURETTE. Can you tell us a little something about the cars that were delivered yesterday, and what kind of operation is going to be conducted up in Alaska?

Mr. RADER. Yes, they are double deck, full-length, glass dome cars, the largest passenger cars in the world, and they are designed for the luxury tourism market. The Alaska railroad, well, let me see, I should know, I started it, in 1983, has been towing the cars behind their scheduled services of the various cruise companies to Alaska.

They have now made sufficient profits from that operation to reinvest in building their own luxury tour cars, and they are entering the market. The combined operation of all of those tour cars together has taken an operation that was losing millions of dollars in 1983 on passenger service, and turned it into one which has a substantial positive cash flow from passenger service.

Mr. LATOURETTE. I am glad you mentioned that. There is sort of a great myth in this country that you cannot turn a profit with passenger rail service. I just heard you describe what is going on in Alaska. I mean, should we be thinking about separating passenger rail service from sort of the tourism side, as opposed to the getting people to work side of things?

Mr. RADER. Yes, I think they are certainly two different operations, two different markets, and must be approached mentally differently. How one approaches that, I am not sure I have the answer.

But the recognition is that, as an example, long distance trains are not transit, but are really, I think, the tourism kind that the Alaskan railroad has. Tourism supports the essential transportation service. So the challenge we all know is to make essential transportation pay for itself.

Mr. LATOURETTE. How many people can fit in one of your cars?

Mr. RADER. The double-deckers upstairs are usually 90 to 120, and downstairs they are about 20 less. So they can fit 200 passengers comfortably.

Mr. LATOURETTE. Thank you very much.

Mr. Collins, can you give me a real world example of where Operation Respond might have assisted in an emergency situation?

Mr. COLLINS. Yes, Mr. Chairman, the first one that comes to mind is an incident in Rochester, New York. It basically ended up on a short line railroad, where the Rochester Fire Department did not have access to that short line railroad's database, but they had access to the CSX database.

They were able to go in and get the information on that particular leaking tank car to help them understand what chemicals they were dealing with in this incident in Rochester, New York.

Similarly, in the Salt Lake City incident that just happened out in Utah, where they had to evacuate 6,000 people with the confusion over the chemicals, the Midvale Fire Department actually queried on our system. They queried the Union Pacific, the BNSF and the Utah Railway, the three that we have in that jurisdiction, to obtain information on the contents of those cars that were leading to the evacuation.

Last year, in 2004, on the freight railroad side, we had over 1,800 queries of the system. Some of this is training and some of this is testing, which is good, because it is familiarizing people with how to use the system. But it also is an indication of the concern by the communities over issues that they need data on.

Mr. LATOURETTE. You mentioned, I think, that all seven Class 1 railroads have voluntarily signed agreements with you. What do you think the reach is of Operation Respond? That would be part one of my question. Then two, do you also cover commuter lines, such as Metro North in New York?

Mr. COLLINS. Yes, that is true for all the Class 1 railroads in Canada and the United States, and we recently signed an agreement with the TFM in Mexico, although we have not launched that service yet, until we get the full Spanish version working.

The reach is going to be the reach of the full extent of the Class 1 railroads. The example that I mentioned with the short line situation, it is really the Class 1s that are originating this hazardous materials.

They have the data. Even though they may pass it off to a short line that is not in our system, the people that use our software understand that they can query on all railroads, for that matter, to find out what chemical they are dealing with.

Now with the passenger train side of things, I am very pleased. Particularly along the Northeast Corridor, we have the Virginia Railway Express. We have MARC. We have Amtrak. We have the Long Island Railroad in New York. We have the New Jersey Transit in New York. We have Metro North in New York. We have a real solid base along the Northeast Corridor of all the commuter operators that have joined our system.

We have several out west, as well. We have one in Toronto, Go Transit, that is now in our system. There are several voids there

that we would like to fill. We have been working with APTA on programs to try to encompass that particular industry.

Mr. LATOURETTE. Thank you very much.

Mr. Hill, I think you mentioned that your Advance Speed Enforcement System is already deployed in the Northeast Corridor. Is that right?

Mr. HILL. That is correct.

Mr. LATOURETTE. It is my understanding that most commuter rail systems in the country have, I think they are called wayside signals, which are basically traffic lights at the site. But some of the higher speed corridors like the Northeast Corridor, require cab signals, which are more expensive to install. Does your system require the use of cab signals, or can you use it without?

Mr. HILL. It can be used definitely without. It can be installed without any other signaling infrastructure that would be existent today. In the Northeast Corridor, we have deployed it in conjunction with the cab signaling that is there. So you have both continuous and what we call intermittent cab signaling, which is the speed enforcement system.

But outside of the Northeast Corridor, generally on Class 1 and other operating railroads, there is very little cab signaling deployed.

Mr. LATOURETTE. Lastly, with the Railroad Track Integrity System that you talked about, I think it would be very important to know if there is a missing track up ahead. Can you tell us just a little bit about how that system works in comparison to what we have in existence today?

Mr. HILL. Basically, the Track Integrity System is a technology that was developed at Union Switch many years ago. It was latent. We had not used it.

The system actually sleeps most of the time, and really is woken up when a train would come along in Dark Territory. So it is specifically for dark or unsignaled territory.

We have deployed this technology on a trial basis, as your colleague, Mr. Graves, indicated, on the Burlington Northern Santa Fe. There is a 50 mile test area there, where this technology is being deployed.

Basically, as a train approaches, the technology wakes up. It checks the track ahead, to make sure that there are no broken or missing rails. Then the information is communicated back to the locomotive, to indicate that everything is clear ahead.

In that particular demonstration on the Burlington Northern Santa Fe, they have already recognized or detected eight broken rails in the period that the equipment has been installed. This obviously can be a cause for major derailments.

Mr. LATOURETTE. How far ahead can it see? I mean, is it the whole 50 miles that you have wired, or how does it work?

Mr. HILL. One particular track circuit of this technology can reach nearly five miles. Over a 50 mile territory we would have like 10, what we call track circuits, or individual sections of track that we check.

Mr. LATOURETTE. Thank you very much.

Mr. Menendez?

Mr. MENENDEZ. Thank you, in Mr. Hill's response to your question, Mr. Chairman, I thought there was only one broken rail around here.

Mr. LATOURETTE. That is one too many.

[Laughter.]

Mr. LATOURETTE. I want to thank all the panels. Mr. Collins, let me ask you, based on the work you have done with the industry to develop a Railroad Incident Location Program, what would it take, if you have any estimates, for a national program? What would it cost and how long would it take to implement?

Mr. COLLINS. Okay, I would like to turn this over to Dr. Boons, since he is running this program for us.

Mr. BOONE. Thank you very much, Dan. This is a good example of taking advantage of the technology changes that are going on in the 911 arena and with the advent of the cellular telephone.

There is a great deal of activity, as I am sure all of you on the Subcommittee know, going on to address locations, take imagery at the county level, and do a great deal of work in determining streets and roads. All of this is being done to improve emergency response as a general matter.

One of the things that we believe can be done is to take advantage of the excellent engineering data that the railroad industry already has, as Mr. Hill described, literally locating a lot of the major features that would be needed for a responder to adequately match a highway mile post or a street intersection with where to go to reach a railroad incident.

This is particularly important, as the railroads have done an outstanding job in reducing grade crossings, which are the traditional way to determine where rail and highway intersections occur, and also locates where you are on the railroad.

That is a long way around to say that a good deal of the work is already underway by the emergency community, and a lot of the data exists within the railroads themselves.

We think, with a cooperative program, recognizing the security needs of the data itself, and the fact that it is proprietary data and needs to be brought into a uniform format, that over a period of four to five years, we do not think it would be in excess of $30 million to $50 million to do the entire Nation.

Now, having said that, not every piece of every railroad needs to have high resolution imagery or needs to have the same level of detail that you would have, for example, in metropolitan New Jersey or along the shore in Ohio. But you would want to have a practical way of doing this sufficient to meet the needs of the 911 centers and the others who have to literally figure out how do I locate where it is and then how do I get to it.

Mr. MENENDEZ. Thank you, I understand it is a response and safety enterprise. Do you see any applications as it relates to security?

Mr. COLLINS. I think in the testimony, I tried to address the security side, and particularly our work with the passenger train-carrying railroads, where the schematical presentations of their equipment are contained within our software.

Then if there are incidents on board those particular pieces of equipment, the responding law enforcement agencies could obtain

the data, even before they went into the car: the width of the aisles, if there were incidents with windows, understanding what the fabrication of the windows are; all kinds of critical information they might need.

The SWAT teams, for example, might need this before they went in and actually put their plan of action in place.

Mr. MENENDEZ. Thank you, Mr. Collins.

Mr. Rader, based upon your presentation, you should be selling like hotcakes.

[Laughter.]

Mr. MENENDEZ. It sounds like you are on your way. I am just wondering have you experienced, for example, in your double deck cars, any challenges or any obstacles?

Mr. RADER. Certainly, we have. The biggest challenge we face is, if you pick up a railroad specification today for new cars, it will ask for five to ten years of railroad-proven service. I do not have five to ten years of railroad-proven service in a new car.

However, that is the wonderful thing about what Congressman Mica has helped put together in Florida. We will have that demonstration over the next two years. Then, yes, I think it will go like hotcakes.

In fact, I think one of the real opportunities here, if you look at the economics, the savings on these cars would literally pay the principle and interest over the life of the car, if you were financing it at Treasury rates.

Mr. MENENDEZ. I have just one technical question for myself. They are self-propelled, and you talked about how there are different ones on different cars. What happens when, for argument's sake, one goes out? Does it continue to self-propel itself through the independent power?

Mr. RADER. Yes, they are independently controlled. That is the joy of it. If one goes down, the computer on the adjoining engine says, I am not hearing from my friend. I am in control, and it takes over.

Mr. MENENDEZ. Thank you very much.

Mr. LATOURETTE. I thank you, Mr. Menendez. I want to thank this panel, and I want to thank all of the witnesses on all three panels. I learned a number of things today, and I appreciate your being willing to share with us. I want to thank Mr. Menendez for filling in so ably for Ms. Brown, who hopefully will be back with us next time.

As with the other panels, there may be some questions that people may have that we will forward to you, and if you will be so kind as to respond, we would appreciate that. There being no further business to come before the Subcommittee, we stand adjourned.

[Whereupon, at 1:05 p.m., the subcommittee was adjourned.]

Testimony of
Robert J. Chipkevich, Director
Office of Railroad, Pipeline and Hazardous Materials Investigations
National Transportation Safety Board
before the
U.S. House of Representatives
Committee on Transportation and Infrastructure
Subcommittee on Railroads
2167 Rayburn House Office Building
April 28, 2005, 10 AM

Good morning, Chairman LaTourette and Members of the Subcommittee. Thank you for the opportunity to testify before you today on behalf of the National Transportation Safety Board (NTSB) on an important rail safety issue, Positive Train Control (PTC).

The NTSB has been investigating train collisions and over-speed rail accidents for over 35 years and issued our first safety recommendation in 1969 following a head-on collision between 2 Penn Central commuter passenger trains in Darien, Connecticut. The Safety Board recommended that the Federal Railroad Administration (FRA) "study the feasibility of requiring a form of Automatic Train Control at points where passenger trains are required to meet other trains" (R-70-003).

Since 1970, the Safety Board has issued numerous safety recommendations related to positive train separation. Our most recent safety recommendation was issued in 2001, following the investigation of a collision involving three Conrail freight trains in Bryan, Ohio. The trains were operating in fog, when a faster moving train missed a stop and proceed signal and hit the rear-end of a train that had slowed because of poor

visibility. A third train, coming from the opposite direction, struck the two derailed trains. The Safety Board concluded that a fully implemented Positive Train Control system would have prevented the collision and recommended that the FRA "facilitate actions necessary for the development and implementation of positive train control systems that include collision avoidance, and require implementation of positive train control systems on main line tracks, establishing priority requirements for high-risk corridors such as those where commuter and intercity passenger railroads operate" (R-01-6).

This safety recommendation was reiterated to the FRA after a Burlington Northern Santa Fe freight train collided head-on with a Metrolink passenger train in Placentia, California in 2002. The probable cause of this accident was the freight train crew's inattentiveness to the signal system. Contributing to this accident was the absence of a positive train control system that would have automatically stopped the freight train short of the stop signal and thus prevented the collision.

In the past 6 years, the NTSB has investigated 38 railroad accidents where Positive Train Control is a safety issue. Causal factors have often been attributed to train crew mistakes and failure to operate trains in accordance with operating rules. Human factor causes have included fatigue, sleep-apnea, use of medication, reduced visibility and distractions such as cell phone use.

Automatic train control systems are safety redundant systems that can override mistakes by human operators and prevent collision and over-speed accidents.

The FRA accident database for 2003 also attributes human factors as causal to most collision accidents. The 2003 data show that there were 146 head-on, rear-end and side collision accidents, and that 133 of those accidents, or 91 percent, are attributed to human factor causes.

The preliminary FRA accident database for 2004 also attributes human factors as causal to most collision accidents. The 2004 preliminary data shows 202 head-on, rear-end and side collision accidents (an increase of 56 accidents), and that 184 of those accidents, or 91 percent, are attributed to human factor causes.

NTSB is currently investigating 5 accidents involving freight train collisions. These accidents occurred in Washington State, New Mexico, Texas and Florida. As a result of a collision between 2 trains in Macdona, Texas, (near San Antonio), on June 28, 2004, a tank car filled with chlorine was breached, resulting in 3 fatalities and a significant public evacuation. On Wednesday, an NTSB Board of Inquiry into the cause of this accident completed the taking of testimony from 12 witnesses over 2 days. NTSB will examine whether Positive Train Control could have prevented the Macdona accident and another accident that occurred in Graniteville, South Carolina, on January 6, 2005. After the Graniteville accident, a switch on the main track was found in the open position

to a siding. As a result of this accident, a tank car filled with chlorine was breached, resulting in 9 fatalities. Both of these accidents are still under investigation.

Progress on the implementation of Positive Train Control has been slow. This safety issue has been on the NTSB's List of Most Wanted Transportation Safety Improvements since 1990. In 2003, the Senate Appropriations Committee noted that the pace of development and implementation of collision avoidance technologies was inadequate, and it criticized the lack of an industry-wide integration plan. (Report 107-224).

Notwithstanding the slow progress on Positive Train Control, the FRA has worked with railroads and suppliers to develop regulatory standards that address modern electronic systems and emerging technology in the signal and train control arena. The FRA issued a final rule to establish *Standards for the Development and Use of Processor-Based Signal & Train Control Systems*. The final rule should provide safety-critical standards that equipment must meet for use in PTC systems, but it will not provide interoperability standards that need to be addressed when equipment operated by different railroads is used on the same track.

Initiatives have been taken by some railroads to develop and install PTC systems. These include Amtrak, which has installed PTC on 436 miles of track that it owns on the Northeast Corridor and 45 miles of track on its Michigan Line; New Jersey Transit, which has installed PTC on 23 miles of its system and it expects to have PTC on all 540

miles of its system by the end of 2006; New Jersey Transit placed additional emphasis on this program following a head-on collision between 2 of its trains in 1996; and the Alaska Railroad, which operates both passenger and freight trains, is installing PTC on all 611 miles of its track. Alaska Railroad has now equipped all of its 62 locomotives. This project is funded, in part, by the FRA, and plans are to have PTC operational, system-wide, by the end of 2006.

Further, the FRA, the Association of American Railroads and the Illinois Department of Transportation are funding the North American Joint Positive Train Control Project over 120 miles of track on the St. Louis/Chicago corridor. A goal of this project is to help address equipment and operational issues that occur when different railroads use the same track.

Last month, the NTSB held a symposium at the Academy to learn about the status of train control technologies that are being evaluated and applied, and to invigorate the dialogue between government and private organizations on this vital safety issue.

Positive train control systems can prevent human factor caused accidents, and the NTSB will continue to urge implementation of PTC systems through our accident investigations and the attention of our List of Most Wanted Transportation Safety Improvements.

Thank you again for the opportunity to testify, and I am available to answer any questions.

✓

NTSB

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Washington, DC 20594-0001
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JUN 01 2005

Honorable Robert Menendez
U.S. House of Representatives
2238 Rayburn House Office Building
Washington, D.C. 20515

Dear Representative Menendez:

On Thursday, April 28, 2005, the Committee on Transportation and Infrastructure, Subcommittee on Railroads, held a hearing on new technologies for rail safety and security. Mr. Robert Chipkevich, Director of the Office of Railroad, Pipeline and Hazardous Materials Investigations, of the National Transportation Safety Board (NTSB), was a witness at that hearing.

Upon the conclusion of his testimony, Mr. Chipkevich was asked to respond to a question regarding the number of public hearings held at the Safety Board for the past five years for the record. Enclosed for your information is a copy of all public hearings held by the NTSB from 2000-2005. A public hearing has also been scheduled for June 13-15, 2005, regarding Pinnacle Airlines flight 3701, which occurred near Jefferson City, Missouri on October 14, 2004. Also enclosed for your information is a copy of the Safety Board's purpose and procedure on conducting a public hearing.

I hope this information responds to your question and, if you have any additional questions or concerns, please do not hesitate to contact me.

Sincerely,

Mark V. Rosenker
Acting Chairman

Enclosures

cc Glenn Scammel, Staff Director
Tracy Mosebey, Clerk

News & Events

PUBLIC HEARINGS

As part of its investigation into certain accidents, the Safety Board may hold a public hearing to record evidence presented by persons involved in the accident and by parties to the investigation. See the detailed description for general information. The public and the media are welcome to attend the hearing and listen to the proceedings, or they can view a webcast of the hearing. See Previous Hearings for on-line access to exhibit items and other detailed information from those dates.

Policy on Photographing, Video, and Audio Recording of NTSB Proceedings

Media Contact: NTSB Public Affairs Office, (202) 314-6100.

Upcoming Hearings

Date/Time/Location	Topic(s)	More Information
TBA	TBA	Webcast Information

Previous Hearings

Date	Topic	More Information
April 26-27, 2005	Collision between Union Pacific Railroad (UP) and Burlington Northern Santa Fe (BNSF), Macdona, Texas, June 28, 2004. Webcast Archive: *(Webcast Technical Support)* Day 1 - April 26, 2005: Real Video | Windows Media Day 2 - April 27, 2005: Real Video | Windows Media	Details
July 27-28, 2004	Aviation Image Recording	Details
May 20-21, 2003	Crash of Air Midwest Flight 5481	Details
March 18-19, 2003	Medical Oversight of Non-Commercial Drivers	Details
Oct 29- Nov 1, 2002	Crash of American Airlines Flight 587 November 12, 2001 Belle Harbor, NY	Details Press Release
July 15-16, 2002	Minot, North Dakota	Press Release

	Derailment Canadian Pacific Railway January 18, 2002	
May 9, 2002	Emery Worldwide Airlines Flight 17 near Rancho Cordova, Ca. February 16, 2000	Press Release Preliminary Report
December 13-15, 2000	Alaska Airlines Flight 261 near Port Hueneme, California January 31, 2000	Details Press Release
November 15-16, 2000	Pipeline Safety Hearing	Details
January 26-29, 2000	American Airlines Flight 1420 Little Rock, Arkansas June 1, 1999	Details Media Advisory Press Release SB99-35
January 20-21, 2000	Effectiveness of Commercial Driver Oversight Programs	Details

About the NTSB

PUBLIC HEARINGS [Schedule]

PURPOSE

The National Transportation Safety Board conducts public hearings for the purpose of supplementing the facts discovered during the on-scene and subsequent follow-up investigation of the accident. Public hearings generally are held with regard to a major accident in which there is wide and sustained public interest, or significant safety issues. Testimony is obtained through public hearings to ensure an accurate, complete and well-documented factual record.

The Safety Board is a public agency, and conducts its investigations in a public manner. A public hearing enables the Safety Board to meet its mandate to conduct in-depth objective accident investigations, without bias or undue influence from industry or other government agencies. It is an exercise in accountability: accountability that the Safety Board is conducting a thorough and fair investigation and accountability on the part of industry and other government agencies that they are fulfilling their responsibilities.

The Safety Board does not determine the rights or liability of the parties involved in the accident. Therefore, matters dealing with such rights or liability are excluded from the hearing proceedings. Instead, the hearing is intended to collect information that will assist the Safety Board in its examination of the safety issues arising from the accident.

PARTICIPANTS

A hearing involves Safety Board investigators, other parties to the investigation, and expert witnesses called to testify.

At each hearing, a Board of Inquiry is established that is made up of senior Safety Board staff, chaired by the presiding Board Member.

The Board of Inquiry is assisted by a Technical Panel. Some of the Safety Board investigators that have participated in the investigation serve on the Technical Panel. Depending on the topics to be addressed at the hearing, the panel often includes specialists in the areas of aircraft performance, powerplants, systems, structures, operations, air traffic control, weather, survival factors, and human factors. Those involved in reading out the cockpit voice recorder and flight data recorder, and in reviewing witness and maintenance records also might participate in the hearing.

Parties to the hearing are designated by the Safety Board Member who is the presiding officer of the hearing. They include those persons, governmental agencies, companies, and associations whose participation in the hearing is deemed necessary in the public interest and whose special knowledge will contribute to the development of pertinent evidence are designated as parties. Typically, they include the Federal Aviation Administration, operator, airframe manufacturer, engine manufacturer, pilots union, and any other organization that can assist the Safety Board in completing its record of the investigation. Except for the FAA, party status is a privilege, not a right. Parties are asked to appoint a single spokesperson for the hearing.

Expert witnesses are called to testify under oath on selected topics to assist the Safety Board in its investigation. The testimony is intended to expand the public record and to demonstrate to the public that a complete, open and objective investigation is being conducted. The witnesses who are called to testify have been selected because of their ability to provide the best available information on the issues related to the accident.

News media, family members, lawyers, and insurance personnel are not parties to the investigation, and are not permited to participate in the public hearings.

PROCEDURE

The decision as to whether a public hearing will be held is made by the Safety Board. Hearings are generally scheduled a sufficient period of time after the accident to allow for documentation and preliminary evaluation of all factual data, preliminary exploration of the issues, conduct of necessary tests, and the preparation or gathering of necessary exhibits.

Prior to the hearing, a prehearing conference is held. It is attended by the Safety Board's Technical Panel and representatives of the parties to the hearing. During that conference, the areas of inquiry and the scope of the issues to be explored at the hearing are delineated and the selection of the witnesses to testify to these issues is finalized.

The witnesses are questioned first by the Board's Technical Panel, then by the designated spokesperson for each party to the hearing and finally by the Board of Inquiry.

The Chairman of the Board of Inquiry is responsible for the conduct of the hearing. The Chairman makes all rulings on the admissibility of evidence, and all such rulings are final.

PRODUCT

The record of the investigation including the transcript of the hearing and all exhibits entered into the record will become part of the Safety Board's public docket on the accident.

Following the hearing, investigators will gather additional needed information and conduct further tests identified as necessary during the hearing. After the investigation is complete and all parties have had an opportunity to review the factual record, both from the hearing and other investigative activities, a technical review meeting of all parties is convened. That meeting is held to ensure that no errors exist in the investigation, and that there is agreement that all that is necessary has been done.

On rare occasions, the hearing may be reopened when significant new additional information becomes available, or follow-up investigation reveals additional issues that call for an airing in a public forum such as a hearing. This was most recently done in the Safety Board's investigation of the September 8, 1994 accident involving USAir flight 427 at Aliquippa, Pennsylvania, near Pittsburgh.

After the hearing and fact finding portion of the investigation are completed, the Safety Board staff completes its analysis of the facts. Parties do not participate in the Safety Board analysis, although they are encouraged to submit findings, recommendations and probable cause statements that they believe the Safety Board should conclude from the record. The final report of the investigation is completed by the Safety Board staff and forwarded to the Safety Board for its deliberation and adoption.

The final report is discussed and adopted by Board Members at a public meeting held in Washington,

D.C. Non-Safety Board personnel, including parties, cannot interact with the Board during that meeting. Copies of the final report, containing the findings, probable cause, and safety recommendations are provided to families, the public and the parties.

STATEMENT OF
DANIEL M. COLLINS
PRESIDENT
THE OPERATION RESPOND INSTITUTE, INC.
BEFORE THE
U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
SUBCOMMITTEE ON RAILROADS

APRIL 28, 2005

Thank you Mr. Chairman. My name is Daniel M. Collins. I am Chairman of the Board and President of the Operation Respond Institute, Inc. On behalf of the carriers and emergency responders that support Operation Respond, in partnership with Federal agencies, I am honored to provide the following testimony on new technologies for railroad safety and security. Accompanying me here today is Dr. James W. Boone, Executive Vice President of Operation Respond and Mr. Gerald Lynch, Executive Director of the Regional Information Sharing System (RISS), one of our strong law enforcement partners.

Mr. Chairman, I would like to express the gratitude of the Operation Respond team for your foresight in holding this hearing. Also, to acknowledge your acceptance to serve on the Operation Respond International Steering Committee along with your esteemed colleague, the Honorable Nick J. Rahall of West Virginia. The presence of the both of you adds an element of importance and national interest to all that we do and is a motivation for all of us.

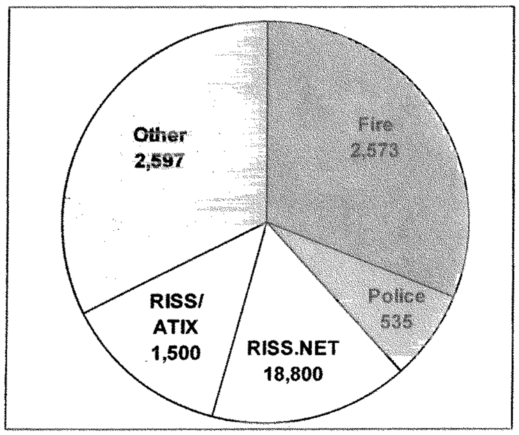
Operation Respond has been involved in developing software products for first responders since 1995. Yes, in April, we celebrated ten years as a non-profit institute dedicated to first responders. We are not new kids on this block. We have learned through trial and error how to package software that is easy to use by responders, not burdensome to the carriers and that provides accurate and timely data. We could not have accomplished all that we have without the assistance of the International Association of Fire Chiefs, the International Association of Fire Fighters, the National Volunteer Fire Council, the International Association of Chiefs of Police and the International Union of Police Associations. These response agencies and the Association of American Railroads and the American Public Transportation Association have been there for us time and time again to fine tune our products and assist with dissemination and training.

Current Status of OREIS™

Operation Respond's principal software, the Operation Respond Emergency Information System (OREIS™) is currently deployed in over 26,000 emergency response agencies across the United States, Canada and Mexico, reaching an estimated one million responders. Among other components, this software provides a direct link between the software user and the manifests of participating railroads. Through this mechanism, responders can obtain verification of hazardous materials contents of leaking rail cars in less than one minute. Besides the verification, the system provides response guidance on

the particular chemical. Our goal is to make sure that the **first responder is not the first victim.**

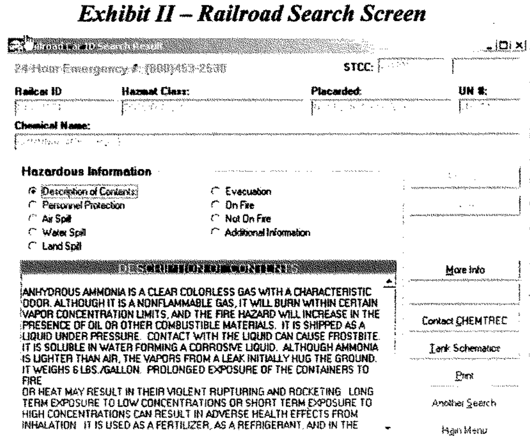
Exhibit I – OREIS™ Installations



All Class I Railroads in the US and Canada have signed license agreements with Operation Respond facilitating the exchange of information. We have a signed agreement with the TFM in Mexico and are working on a full fledged Spanish version. Also, many regional and short lines participate, such as the Alaska Railroad and Montana Rail Link. Please see Attachment A for the entire list.

Basically, Mr. Chairman, the freight railroads have stepped up to the plate. They provide, through our secure software, all the information they have on chemical contents to responders along their routes. This is done on an exception basis, if and when the need arises. A typical screen appears as Exhibit II.

Exhibit II – Railroad Search Screen



In calendar year 2004, this feature within the software was activated over 1,800 times, for training, drills, testing and incidents. Exhibit III summarizes activations.

Exhibit III – Railroad Freight Activations

2004 OREIS Freight Railroad Activations

Top 10 States/Provinces		**Railroad Activation**	
State A	206	Railroad A	5
State B	100	Railroad B	213
State C	91	Railroad C	232
State D	88	Railroad D	292
State E	87	Railroad E	118
State F	87	Railroad F	715
State G	84	Railroad G	23
State H	80	Railroad H	256
State I	80		
State J	77		

TOTAL US/Canada = 1,856

Now to address the topics specifically mentioned in your letter requesting this testimony. I will address three of these topics, improved infrastructure inspection and security technologies, better emergency planning and coordination and modern passenger coach technologies.

Improved Infrastructure Inspection and Security Technologies.

Mr. Chairman, a railroad accident or terrorist incident, especially one involving hazardous materials or passengers, presents special challenges for fire and law enforcement response, and for analysts assessing the vulnerability and strengths of the nation's railroad infrastructure. I would like to relate to you and the Committee our views on these challenges, and some suggested solutions.

These challenges occur in a time when emergency response and dispatching/call center resources at local, county and state levels are confronting unprecedented levels of emergency service needs, including Homeland Security issues. Fire, rescue and EMS departments, and police and sheriffs' departments now have increased responsibilities for Homeland Security, which also impacts the nation's 911 Centers and other Public Safety Answering Points (PSAP's). Few resources can be devoted exclusively to meet these new requirements, especially in volunteer organizations with limited budget sources, high personnel turnover and constant training needs. Accordingly, any efforts that would assure the efficient deployment of available emergency response resources when an incident occurs would be warmly welcomed by America's responders.

Emergency responders and their dispatchers require certain data and information in order to properly "size up" the response actions needed. Dispatchers must make

immediate judgments regarding the **nature of the emergency** (fire, medical emergency, criminal activity, spill, theft, terrorism, natural disaster, hazmat, etc.) Once having done so, the **exact location *(addressing)* of the incident** will determine the jurisdictions to be involved and the status of available units. Finally, in many cases, the dispatcher and responding units may need supplemental information on **how to reach the incident scene,** in terms of road access and obstacles/dangers to equipment or personnel, if any.

We believe responders to rail transportation incidents often need help to confirm the exact incident location and/or how best to reach it. Railroad infrastructure landmarks, features and terminology are not always understood by responders and have led to public safety dispatchers and responders wasting valuable time finding trains in distress or when answering other urgent calls for assistance. For example, a railroad mile post can not be directly related to a mile marker located along a nearby highway, unless it is assigned geographic coordinates in a geographic information system (GIS). Literally, the time saved by being able to quickly relate rail infrastructure to nearby streets and roads can diminish an incident's impact, and perhaps save the lives of those on board (i.e. passenger trains and crew members) and the public.

Repeatedly, the National Transportation Safety Board (NTSB) has found that prompt response to rail incidents or accidents is the key to reducing the severity of injuries to passengers and employees, property damage, and collateral damage. *Prompt and sure response is never more critical than when dealing with actual or threatened terrorist acts.* Not all such threats involve rail passenger stations, such as the 2004 bombing in Madrid, Spain. Fires, collisions, and derailments – whether they are intentional or accidental -- require immediate attention by America's public responders along the nation's rail routes, but even more critical are responses to on-board hostage or other law enforcement or terrorist emergencies, which can occur literally anywhere. Examples of typical scenarios include delays caused by the inability to quickly determine where a train is actually located, to literally responding to the wrong side of a river. In response to these situations, the NTSB has recommended that railroads provide milepost information to public agency emergency dispatch organizations to assist in determining incident location. *(NTSB Safety Recommendation R-01-22; December 20, 2001.)*

Operation Respond has found that a searchable database of georeferenced railroad features, designed to overlay on aerial or satellite imagery and street maps, enables emergency responders to quickly and reliably reach an incident site. In 2004, under Department of Homeland Security sponsorship, Operation Respond developed and delivered an enhanced GIS and overhead imagery system for DHS and Amtrak Police use in planning and emergencies on the Amtrak-owned Northeast Corridor (NEC), from Washington to Boston. The project was a highly focused effort completed prior to the convention activities in New York and Boston, respectively. Operation Respond's Amtrak NEC Rail Incident Location System was developed as a stand-alone, rail feature search engine designed to be user self-trained in less than 15-20 minutes.

This new GIS software application can identify the location of specific features along the railroad, including signals, mileposts, bridges and stations. (Please see Exhibits IV and V, below, for search examples.) The system covers the entirety of Amtrak's Northeast Corridor mainline, which runs approximately 457 route miles from

Washington, DC to Boston. The system displays detailed color overhead imagery for a half-mile on either side of the NEC main rail lines, and serves as a working prototype for a national program.

Exhibit IV– NEC Passenger Station Search: Perryville, Maryland

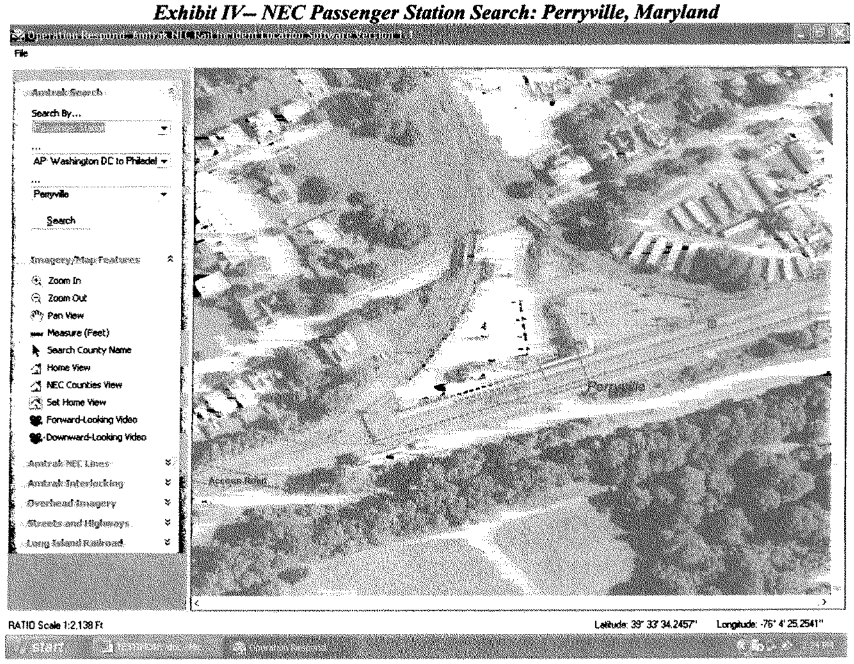
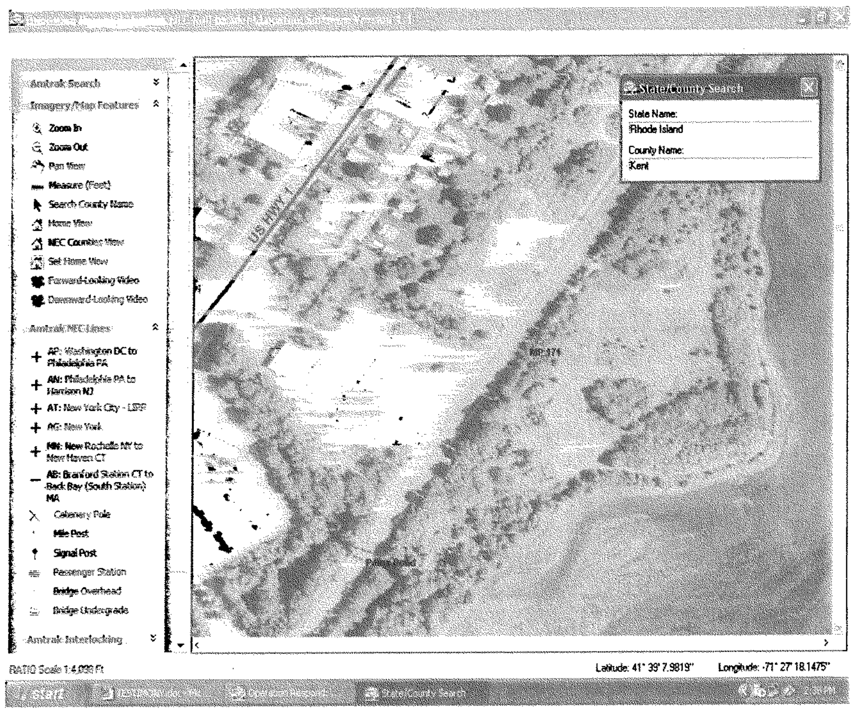


Exhibit V– NEC Milepost Search: MP 174 Kent County, RI



A rail network infrastructure GIS program will also have positive safety implications for the North American rail freight industry. Prompt access to the locations of freight derailments and hazardous materials incidents is paramount to the safety of crewmembers and communities. Having location and scene access geospatial information available together with OREIS™ and its links with the major railroads and the Chemical Transportation Emergency Center (Chemtrec) would give responders substantial assistance at the scene of any freight incident, *and quickly identify which agencies should be notified, based on their location.* This is particularly important where hazardous materials are involved, as nearby responders must quickly establish if such materials are indeed involved, and if so, what the dangers to themselves and the community are. Having such an integrated program available for first responders where mixed freight and passenger services are conducted is also a major step forward in rail safety and security, with application wherever such operations exist.

The emphasis would be on identifying common visual references for the train crew and dispatchers to provide a direct linkage with street maps and overhead imagery, including features in suggested priority order:

(1) Mileposts
(2) Highway grade crossings/pedestrian crossings/farm roads
(3) Railway fixed signals
(4) Interlockings/control points
(5) Bridges (undergrade/overhead) and large culverts/drains
(6) Track turnouts/crossovers
(7) Other relational landmarks, i.e., pipeline and cable markers, electric transmission facilities, access gates, fence entry points, etc.

Operation Respond believes that a cooperative effort with the Association of American Railroads (AAR), rail carriers and emergency response organizations can identify and develop a standardized, geospatial database of essential railroad features for mapping and imagery applications to be used by railroad police and selected public agency emergency response organizations. This core network would contain only the basic geospatial information necessary to fulfill program objectives, while facilitating the inclusion of other features of importance to both railroads and emergency responders – now or later. A coordinated national approach involving all major railroads is a necessity for this purpose, in order to assure that user agencies have access to a uniform, standardized set of data, which will yield economies of design and implementation

The implementation of a national program for the geo-referencing and cataloguing of the railroad infrastructure, integrated with accurate street maps and overhead imagery, will produce substantial benefits for the rail carriers, the emergency communities and the public. These benefits would include:

(1) Allowing carriers to determine the appropriate response organizations in an emergency by matching responder dispatch areas with railroad features and line/route segments;

(2) Assisting railroad police and emergency operations desks to pre-plan deployments of security personnel, locate incidents and communicate with public agency dispatchers and establish effective emergency response, by converting railroad features to a common vernacular -- streets and road intersections

(3) Help responders better understand incident terrain, access limitations, any need for special vehicles, etc., by referral to maps and imagery; and

(4) Allow responders to better understand and protect critical railroad infrastructure, reducing vulnerabilities and saving time and lives in incidents.

Better Emergency Planning

The Operation Respond approach to improved emergency planning and coordination is to bridge the gap between the responders and the carriers. The carriers have a wealth of information that they develop for their own internal management. This information, whether it is right of way engineering data prepared for real estate purposes, hazardous materials invoices for shippers, or passenger train schematics prepared for maintenance personnel contains vital information for responders when incidents occur. Responders need to know the exact location of trains correlated to the nearby highways,

so they can respond quickly. Responders need to know the layout of passenger train cars in case they have to evacuate or extricate passengers.

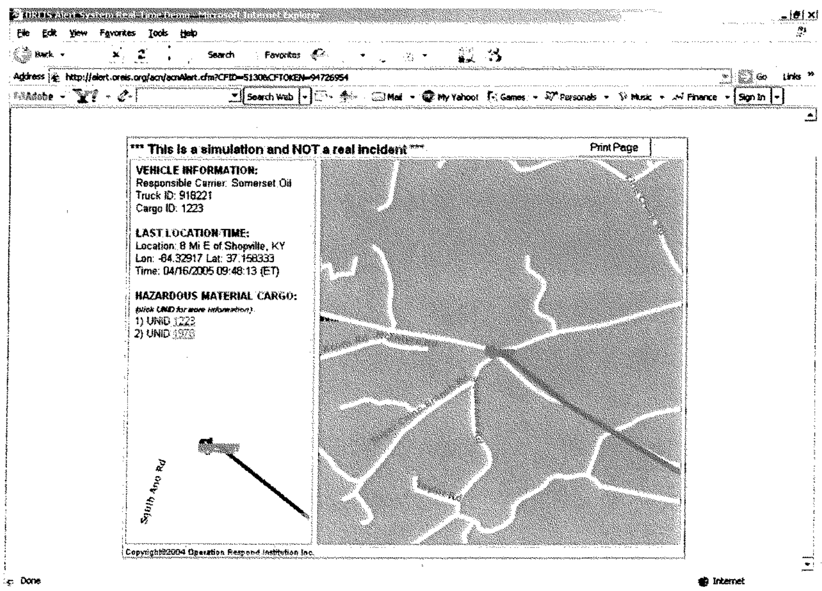
Our approach, Mr. Chairman, is to work with both the carriers and responders. Through easy-to-use software, this complicated railroad data is simplified and reconfigured so that the nineteen year old volunteer firefighter can quickly and easily obtain what they need to commence a response. If I had to use one word, I would say it is **"TRUST"**. The carriers trust Operation Respond in our expertise to secure their data and present it accurately. The responders trust Operation Respond in that we are providing them real world, time sensitive response guidance. OREIS™ is the technology, but **"TRUST"** is the driving force.

Our other motto is "ALWAYS BE PREPARED". While the OREIS™ software is strongly oriented toward incident response, it is also a remarkable training tool. Almost all the carriers have integrated OREIS™ into their hazardous materials training curricula. In fact, the AAR Test Center in Pueblo, Colorado has seventeen sets of OREIS™ in their computerized training classrooms. Many states, including Maryland, New York, Texas, Mississippi and others offer OREIS™ training as part of their fire department new entrant hazardous materials training. Operation Respond, working with the Rahall Transportation Institute at Marshall University is about to launch an OREIS™ internet training capability.

With respect to improved coordination, I would like to introduce a new technology that Operation Respond has been working on for the past two years. Our goal, Mr. Chairman, is to turn the OREIS™ user base, now 26,000 strong and growing, into a transportation incident alert and messaging system. What we are working on with the Association of American Railroads and the individual carriers is a capability that sends alerts and messages to these responders and to the carriers 24-7 operations centers. The alerts/messages can be directly associated with incidents or based on a potential threat such as an explosive device or other possible terrorist actions. In fact we have a license arrangement with the Emergency Services Information Network Corporation (ESINC) in Houston, Texas to develop this network alert and messaging system.

This concept is beginning to bear fruit in the trucking industry. With funds provided through last year's Congressional earmark to FMCSA, Operation Respond has integrated with several corporations using GPS to track trucks. Based on an incident or action such as a driver activated panic button, off route deviation, truck roll over or theft, Operation Respond, upon receipt of message from the GPS tracking firm, will push an alert to OREIS™ users. This is accomplished through cell phones (voice or text), emails, pagers, faxes. Upon receipt of the alert, the responder is directed to a secure web site for details of the incident. Exhibit VI below is an indication of the information on the web site. This technology is very applicable to railroad security and incident response. Operation Respond successfully demonstrated this approach in 2002 with a railroad locomotive traveling from Chicago to St. Louis, as part of an exercise with the FRA/AAR positive train control project.

Exhibit VI – Truck Alerts



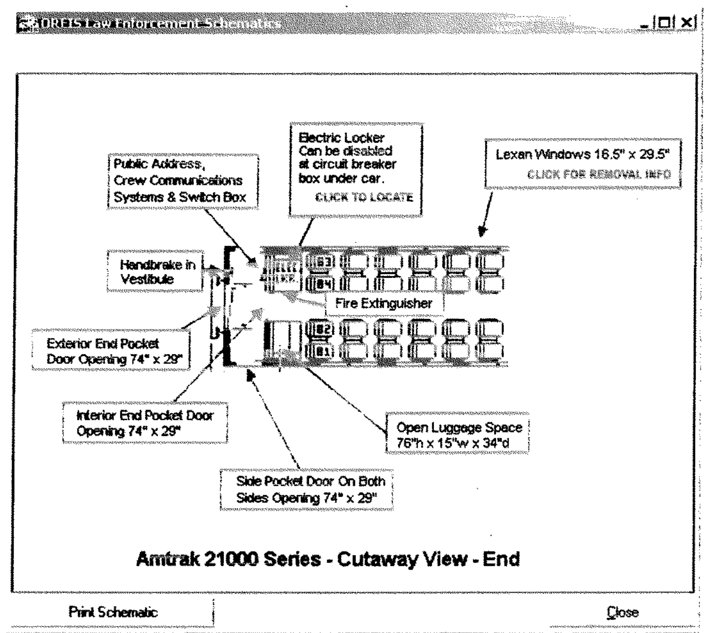
Modern Passenger Coach Technologies

Law enforcement has been particularly interested in Operation Respond passenger coach software. This component of OREIS™ features passenger car and locomotive schematics highlighting emergency information, such as emergency windows and doors, electrical systems and superstructure penetration points. Amtrak has led the way in this feature. At the present time, every Amtrak car and locomotive, including the Acela train is schematically presented in OREIS™. As Attachment A indicates, the response to this feature has led to the addition of many other commuter lines in the US and Canada, as well as VIA Rail Canada.

As Mr. Lynch will attest, the law enforcement component of RISS views these schematics as a very effective tool for dealing with on-board incidents. These could range from identifying locations for hiding bombs, how to approach an on-board hostage situation and for SWAT team pre-planning. Another law enforcement communication system, NLETS – the International Justice and Public Safety Information Sharing Network is now also engaged with Operation Respond to add this feature and, in fact, all of what we do into the NLETS system. When this is completed, Mr. Chairman, which is only weeks away, Operation Respond will be adding another 30,000 agencies with access to OREIS™. NLETS has over 480,000 devices linked to its system. Through this capability, a patrol car located in Cleveland, Ohio will be able to obtain all of OREIS™.

From our vantage point, with passenger train equipment, the more standardization the better. Ideally on all new equipment how to open emergency windows from the outside or inside ideally should be the same on all cars. The composition of the glass should be the same. Numbers on the sides of cars should be clearly visible; this is the key for OREIS™ presentation. This standardization should be across North America. All of these improvements would help emergency responders. Exhibit VII below presents a typical passenger car law enforcement schematic contained within OREIS™.

Exhibit VII – Law Enforcement Schematic



Conclusion / Recommendations

As you can see, Mr. Chairman, what we do from a technological point of view is basically to integrate off the shelf capabilities into useful tools for responders. From various sources of information, we are able to encapsulate the key information into an easy-to-use incident response and preplanning tool. What needs to happen from our perspective is the following:

1. All railroads should participate in Operation Respond. This includes all carriers that haul hazardous materials and/or passengers. This should be voluntary, but with some incentives to help smaller roads with the necessary programming.

2. A national railroad infrastructure search engine along the lines of what I described in my testimony should be developed. The essence of the system is in place. The priority should be:
    - DOD routes
    - Hazardous Materials Routes
    - Amtrak and Commuter Train Routes

   As the project progresses over a series of years, the data could be made available to the responders segment by segment. A plan for updating also needs to be in place.
3. A national transportation incident alert and messaging system needs to be developed. Operation Respond's software users are the ideal group to serve as the network foundation. Users are password protected and authenticated, plus after receiving the alerts, they have the software to deal with the situation.
4. Finally, while the OREIS™ software deployments are indeed growing, the goal needs to be universal coverage. In the case of the railroad industry, this means that all responders located along railroad lines are provided, through one form or another, access to OREIS™. At the present time, we are essentially half the way there.

Thank you Mr. Chairman. My associates and I would be happy to answer any questions.

Attachment A

OREIS™ Freight Railroad Carriers

- Alaska Railroad
- Brownsville and Rio Grande
- Burlington Northern Santa Fe
- Canadian National
- Canadian Pacific
- CSX Transportation
- Kansas City Southern
- Montana Rail Link
- Norfolk Southern
- PTRA
- TFM Railroad
- TGS
- Union Pacific
- Utah Railway

OREIS™ Passenger Railroad Carriers

- Alaska Railroad
- Amtrak
- Caltrain
- GO Transit
- Long Island Railroad
- MARC
- Metro North
- Northern Indiana Commuter Transportation
- New Jersey Transit
- North Carolina DOT
- Rocky Mountaineer
- Royal Celebrity Tours, Inc.
- UTA TRAX
- VIA Rail Canada
- Virginia Railway Express
- Washington Metro Area Transit Authority

Statement by Congressman Jerry F. Costello
Committee on Transportation and Infrastructure
Subcommittee on Railroads
Hearing on New Technologies in Railroad Safety and Security
April 28, 2005

Thank you, Mr. Chairman, for calling this important hearing on railroad safety. I would like to welcome today's witnesses.

According to the Federal Rail Administration (FRA), railroad safety has improved significantly in the past 20 years. However, as I know first hand from past freight derailments in my Congressional district, accidents do still happen, and it is important that we continue to take steps to improve rail safety.

New technologies have resulted in improved rail safety. These improvements include new passenger coaches and locomotives, which meet improved passenger rail equipment safety standards, as well as crash tests to improve safety of new and existing passenger rail cars.

In addition, grade crossing protection technologies, including better engineering, grade crossing elimination, highway traffic enforcement and education, have reduced incidents between automobiles and trains. The

successful Operation Lifesaver program has advanced this initiative and education programs need to continue.

Other technological improvements, such as positive train control (PTC), are expected to make significant changes in rail safety. The Positive Train Control technology is currently being testing in my home state of Illinois. Within the Chicago to St. Louis High Speed Rail corridor, a 120 mile prototype PTC system is being installed from Springfield to Mazonia. This project is being sponsored by the Illinois Department of Transportation, the FRA and the freight railroads acting through the Association of American Railroads (AAR). This project has become a national test-bed for the North American Joint Positive Train Control Project. PTC is a critical component of HSR development by increasing safety, improving track capacity and greater operational efficiency.

I look forward to the testimony of today's witnesses and learning more about these improvements and programs.

JOINT STATEMENT OF

EDWARD R. HAMBERGER

PRESIDENT & CHIEF EXECUTIVE OFFICER
ASSOCIATION OF AMERICAN RAILROADS (AAR)

AND

DR. JOHN M. SAMUELS

SENIOR VICE PRESIDENT - OPERATIONS PLANNING & SUPPORT
NORFOLK SOUTHERN
and
CHAIRMAN - AAR RAILWAY TECHNOLOGY WORKING COMMITTEE

BEFORE THE

U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

SUBCOMMITTEE ON RAILROADS

HEARING ON NEW TECHNOLOGIES

FOR RAILROAD SAFETY AND SECURITY

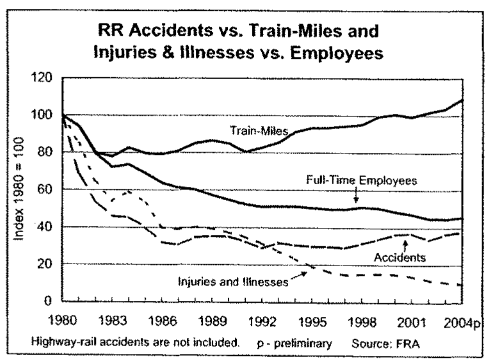
APRIL 28, 2005

Thank you for the opportunity to discuss the critical issue of freight railroad safety. Nothing is more important to our nation's freight railroads than the safety of their employees, customers, and the communities they serve, as is demonstrated by the scope and intensity of the industry's safety efforts.

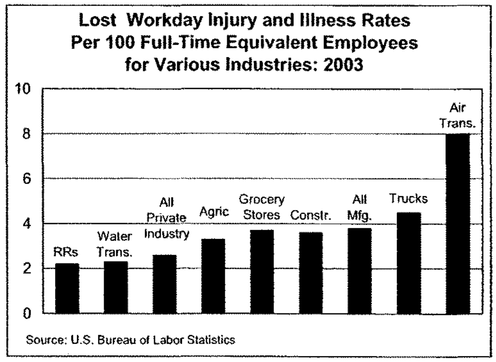
Before we discuss railroad safety, we would first like to express the deep gratitude of our nation's major freight railroads to the members of this subcommittee and the other members of the Committee on Transportation and Infrastructure for their hard work on TEA-21 reauthorization. Through your leadership on this issue you have shown that you understand the importance of transportation to the growth and vitality of our nation, and we commend you for that understanding.

Overview of Rail Safety

Railroads have achieved tremendous improvement in safety since the Staggers Rail Act of 1980 partially deregulated the industry. According to preliminary 2004 Federal Railroad Administration (FRA) statistics, the rail industry has reduced its overall train accident rate 65 percent from 1980 to 2004 and 15 percent since 1990. Meanwhile, the rate of employee casualties has been reduced 78 percent since 1980 and 68 percent since 1990, and in 2004 was the lowest rate on record.

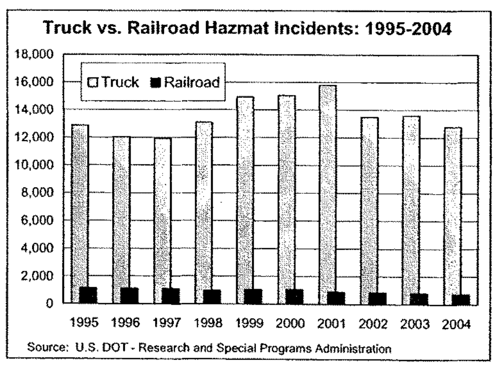


According to the Bureau of Labor Statistics, railroads have lower employee injury rates than other modes of transportation and, indeed, most other major industry groups, including agriculture, construction, and manufacturing. Railroad injuries are no more severe than injuries in U.S. industry as a whole, and U.S. railroads have employee injury rates well below those of most major European railroads.



Railroads are also far safer than trucks. Rail freight transportation incurs an estimated one-fourth of the fatalities that intercity motor carriers do per billion ton-miles of freight moved.

Railroads are also the safest way to transport hazardous materials. Railroads and trucks carry roughly equal hazmat ton-mileage, but trucks have 16 or more times more hazmat releases than railroads. Railroads transport around 1.7 million carloads of hazmat each year, and 99.998 percent of such shipments reach their final destination without a release caused by an accident. Rail hazmat accident rates are down 90 percent since 1980 and 49 percent since 1990.



No one disputes that efforts should be made to increase hazmat safety and security where practical. However, extreme care must be taken to strike a reasoned balance between measures to improve hazmat safety and security, on the one hand, and the need to ensure the free flow of goods on the other. As U.S. Department of Transportation (DOT) Secretary Mineta has remarked, "What we don't want is for our checkpoints to become chokepoints."

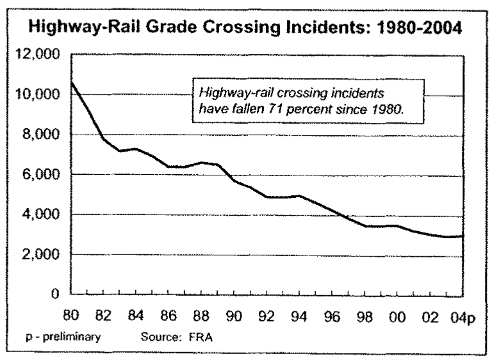
Freight railroads are constantly working to ensure the continued safety of hazmat transport. For example, railroads assist communities in developing and evaluating emergency response plans and provide training for emergency responders.

Railroads also participate in a variety of R&D efforts to enhance tank car and hazmat safety. For example, railroads, tank car builders, tank car owners, and others jointly fund the Tank Car Safety Research and Test Project (Project), which carefully analyzes accidents involving tank cars and continually updates a comprehensive database on the precise nature of damage to tank cars. Analysis of these data improves safety by improving researchers' ability to identify the causes of tank car releases and help prevent future occurrences. The database is often cited by the DOT as a role model for other modes of transportation.

In addition to data gathering and analysis, the Project is also engaged in numerous ongoing research efforts, including efforts aimed at developing better steels for tank cars; measuring the railroad operating environment to refine tank car design requirements; investigating the forces generated in accidents to better understand ways to further improve tank car damage resistance; determining the effects of thermal protection degradation of rail tank cars in service; and providing validation and input data for a model used to evaluate the effects of fire on tank cars. Beyond the Project, the rail industry and rail suppliers are constantly investigating other ways to enhance tank car safety.

Collisions at highway-rail grade crossings and incidents involving trespassers on railroad rights-of-way are another critical safety problem. In 2003, these categories accounted for 96 percent of rail-related fatalities. Although these incidents generally arise from factors largely outside railroad control — a June 2004 report by the DOT's Office of Inspector General found that "Risky driver behavior or poor judgment" accounted for nearly all public grade crossing accidents — railroads are determined to help find ways to reduce the frequency of crossing and trespasser accidents.

And, in fact, significant progress is being made. The number of grade crossing accidents and casualties has fallen steadily over the years. From 1980 to 2004, the number of grade crossing collisions fell 71 percent, injuries fell 73 percent, and fatalities fell 56 percent. These reductions are the direct result of the billions of dollars railroads themselves have expended over the years on grade crossing maintenance; intensive efforts by railroads and others (especially Operation Lifesaver) to educate the public about the dangers of grade crossings; the closure or grade separation of thousands of grade crossings; and the Section 130 program, which provides federal funding for crossing improvements.



All of these impressive improvements in rail safety have come about precisely because railroads recognize their responsibilities regarding safety and devote enormous resources to its advancement. Through comprehensive employee training;

massive investments in infrastructure, equipment, and technology (totaling, on average, some $15 billion per year); cooperative efforts with labor, suppliers, customers, communities, and the FRA; cutting-edge research and development; and steadfast commitment to applicable laws and regulations, railroads are actively at the forefront of advancing safety.

Railroads recognize, though, that more work remains to be done, and believe that government, management, and labor must work together to further improve rail safety. Several recent high profile accidents have brought renewed attention to the topic of rail safety, and over the past few years the train accident rate — while remaining at an historically low level — has leveled off. Below we will discuss several ways that railroads are working, especially through the use of technology, to improve safety.

Technological Advancements in Railroading

At a very basic level, railroading today seems similar to railroading 150 years ago: it still consists of steel wheels traveling on steel rails. This apparent similarity, however, masks a widespread application of modern technology and a huge variety of ongoing initiatives to research, test, and apply advanced technologies to promote a safer and more efficient railroad environment.

For decades, much of this new technology has been developed and/or refined at the Transportation Technology Center, Inc. (TTCI) in Pueblo, Colorado. A wholly-owned subsidiary of the AAR, TTCI is generally considered the finest rail research facility in the world. It focuses on programs that enhance railroad safety, reliability, and productivity. The facility's 48 miles of test tracks are used for track structure and vehicle performance testing, component reliability evaluation, damage prevention testing, and examinations of freight ride

quality and passenger comfort. The facility is owned by the FRA, but has been operated by TTCI — which is responsible for all of its operating costs — since 1984.

Some of the recent technological advances that have been important to railroading and rail safety are briefly described below. Many of them are being incorporated in the rail industry's Advanced Technology Safety Initiative (ATSI), a predictive and proactive maintenance system designed to detect and report potential safety problems and poorly performing equipment *before* damage, costly repairs, traffic holdups, and derailments occur.

Technological advances often address particular areas of rail equipment, infrastructure, or operations.

Freight Car and Locomotive Wheels

- *Wayside detectors* identify defects on passing rail cars — including overheated bearings and wheels, low hoses, deteriorating bearings, cracked axles and wheels, and excessively high and wide loads — before structural failure or other damage occurs. Some of the newest wayside detectors being developed use *machine vision* to perform higher-accuracy inspections through the use of digitized images, which are then analyzed using computer algorithms.
- *Wheel profile monitors* use lasers and optics to capture images of wheels. The images show if wheel tread or flanges are worn and, consequently, whether the wheels need to be removed from service.
- Trackside *acoustic detector systems* use "acoustic signatures" to evaluate the sound of internal bearings to identify those likely to fail in the near-term. These systems replace or supplement existing systems that identify bearings already in the process of failing by measuring the heat they generate.

- Wheels constructed with stronger *micro-alloy metals* that resist damage and withstand higher service loads are being developed.

Track and Infrastructure

- Advanced *track geometry cars*, which combine sophisticated electronic and optical instruments, are used routinely to inspect track conditions, including alignment, gauge, and curvature. TTCI is developing an on-board computer system that provides an even more sophisticated analysis capability of track geometry, predicting the response of freight cars to track geometry deviations. This information will better enable railroads to determine track maintenance needs and help improve the safety of day-to-day rail operations.
- *Improved metallurgy and premium fastening systems* have improved the stability of track geometry, reducing the risk of track failure leading to derailments.
- Research is continuing in the development of *designs, materials, and maintenance* techniques for improving the performance of specialized track components used in heavy haul railroading — for example, "frogs," which are track structures used where two rail lines intersect that permit wheels on either rail to cross the other.
- *Rail defect cars* are used to detect internal rail flaws. The AAR and the FRA have jointly funded a Rail Defect Test Facility that railroads and suppliers can use to test improved methods for detecting rail flaws. TTCI is also investigating new rail defect detection technologies. For example, a laser-based ultrasonic system under development by TTCI and researchers from the Johns Hopkins University is scheduled for testing and evaluation later this year.

- Advanced *track grinding* equipment and techniques significantly reduce rail fatigue and sharply improve average rail life.

- *Ground-penetrating radar* and *terrain conductivity sensors* are being developed that will help identify problems below the ground (such as excessive water penetration and deteriorated ballast) that hinder track stability.

- Improved *track lubrication techniques*, including the use of environmentally-friendly soybean-based lubricants, are being introduced to reduce fuel costs and extend rail life.

- Much of the research underway regarding track and infrastructure is related to *heavy-axle load* (HAL) service, which entails the use of heavier, and often longer, trains. HAL-related work is underway on rail steels, insulated joints, bridges, welding, and much more.

<u>Locomotives and Freight Cars</u>

- Thousands of new *AC traction locomotives* are now operating on U.S. railroads. Three AC locomotives can do the work of up to five older DC traction locomotives that they replace. AC traction locomotives often provide higher levels of adhesion, superior braking, less wheel wear, greater fuel efficiency, greater reliability, and lower operating and maintenance costs than older DC traction systems.

- *Advanced fault detection systems* on locomotives monitor a variety of critical functions. State-of-the-art locomotives today can have 20 or more sophisticated microprocessors that monitor and control various subsystems, constantly measuring and checking up to several thousand characteristics of the locomotive and its

operation. For example, one computer oversees functions such as traction control to maximize wheel adhesion on the rails. The contact surface between a rail and wheel is about the size of a dime, but is subject to enormously complicated interactions and forces. Computers help control and compensate for these interactions, thereby enhancing performance and safe operations.

- Major U.S. railroads are deploying *remote control locomotive technology* (RCL) to improve rail safety. In use for many years on Canadian and smaller U.S. railroads, RCL allows rail personnel on the ground to operate and control locomotives in rail yards through the use of a hand-held transmitter that sends signals to a microprocessor on board a locomotive.

  The use of remote control locomotive technology in rail yard operations is safer and more efficient than conventional operations. The FRA agrees. In a May 2004 report, the FRA found that "the deployment of remote control locomotives in and around rail yards has resulted in significant safety benefits." The FRA noted that "RCL train accident rates were…13.5 percent lower than the train accident rates for conventional switching operations over the same time period, while employee injury rates were…an impressive 57.1 percent lower for RCL operations than for conventional switching operations." Because of its safety benefits, the AAR urges the federal government to refrain from imposing regulatory or legislative barriers to the use of remote control locomotive technology.

- *Tank car enhancements*, including head shields, thermal protection, shelf couplers, and pressure relief devices, have helped railroads reduce the overall rail hazmat accident rate by 90 percent since 1980 and by 49 percent since 1990. The

improvements are the result of joint projects by the AAR, the FRA, rail suppliers, rail customers, and others, and are complemented by numerous ongoing initiatives aimed at further improving tank car safety.

- New technologies designed to enhance fuel efficiency are being developed and deployed. Advanced *engine shutdown and startup systems* help keep engine fluids warm and reduce idling. *Consist managers* monitor power needs and automatically decrease power on unnecessary locomotives. And *hybrid engines* that use powerful rechargeable batteries to dramatically reduce emissions and fuel consumption are replacing conventional yard locomotives in some areas.

- Electronically-controlled *pneumatic brakes* use an electronic signal along an on-train communications network to initiate brake applications and releases, thereby permitting the simultaneous application of all brakes on a train and reducing braking distances by as much as 40 percent.

Computers and Communication Systems

- Railroads are constantly expanding their use of state-of-the-art *global positioning systems*, wireless technologies, and other communications advances in a huge variety of rail applications. For example, the *Integrated Railway Remote Information Service* (InteRRIS), which is under development at TTCI, is an Internet-based data collection system with wide potential applicability. An early project using InteRRIS collects data from wheel impact detector systems (which identify wheel defects by measuring the force generated by wheels on tracks) and detectors that monitor the undercarriage of rail cars (which identify suspension systems that are not performing properly on

curves) along railroad rights-of-way. InteRRIS processes the information to produce vehicle condition reports.

- Several *train control* systems are being field tested and evaluated to determine cost effectiveness and interoperability among railroads. The systems use advanced onboard processors to reduce the risk of mainline derailments and collisions.

- *Automatic equipment identification tags* mounted on every freight car and a system of electronic readers strategically located throughout the nation's rail network allow railroads to identify the locations of cars in transit.

- Advanced *computer modeling software* is being used in a huge variety of rail applications, from automating rail grinding schedules and demand forecasting to construction sequencing and operations simulation.

TTCI also supports three affiliated laboratory programs at Virginia Tech, Texas A&M University, and the University of Illinois. Through these long-term programs, the rail industry monitors technological developments, evaluates their suitability to the industry, and supports them towards implementation. TTCI also participates in extensive partnership programs in global railway research to identify and evaluate technologies outside the domestic railway industry.

The railroad industry looks forward to working with Congress, the FRA, its customers, its employees, and others to ensure that rail safety continues to improve.

Jeremy S. Hill
VP Advanced Technology

Testimony to the Subcommittee on Railroads
Thursday April 28, 2005

UNION SWITCH & SIGNAL

wholly owned subsidiary of

ANSALDO SIGNAL
A Finmeccanica Company

Union Switch & Signal Inc. – world leader in rail innovation and technology

- **Founded in 1881 by George Westinghouse**
- **Part of Ansaldo Signal Group of train control companies located throughout the world**
- **Headquartered in Pittsburgh, PA with manufacturing facilities in Batesburg, SC**
  - Approximately 900 US based employees
- **Serve all railroad/transit sectors, worldwide**
- **124 years experience in all facets of railroad control**
- **World leader in the development and implementation of railroad/transit control systems - leader with technological "firsts"**
  - 1900 - Closed Track Circuit-Train Detection System
  - 1910 - Alternating Current (a.c.) Track Circuit-Train Detection System
  - 1922 - On-board Train Control
  - 1966 - Computerized Centralized Traffic Control System
  - 1981 - Consolidated Railroad Computerized Control Center
  - 1984 - Microprocessor-based wayside signaling electronics
  - 1999 - Advanced Speed Enforcement System
  - 2002 - Driver-less train control system approved to CENELEC (European) safety standard
- **Suite of new products and systems to improve rail safety, security, and planning and co-ordination**

Track Integrity System provides a high level of security and safety in unsignaled ("dark") track territory

Railroad Track Integrity System

- Verifies railroad track integrity in non-signaled or "dark" territory
- Provides broken rail detection and detection of "hand-throw" switch position
- Based on US&S' proven coded track circuit technology
  - each track length up to 5 miles
- "Sleeps" during periods of inactivity for power saving
  - ideal for solar applications
- System "wakes-up" with approaching train to report rail integrity status
- System not dependant upon external power sources
- Communicates to train or to centralized monitoring center
- Provides automated infrastructure inspection and security
- Can serve as wayside element for Positive Train Control

Safe Braking Distance

Switch Detection

Monitor

U5

MicroTrax

MicroTrax

MicroTrax

Radio

Operations Control Center

Safety & Security Enhancement

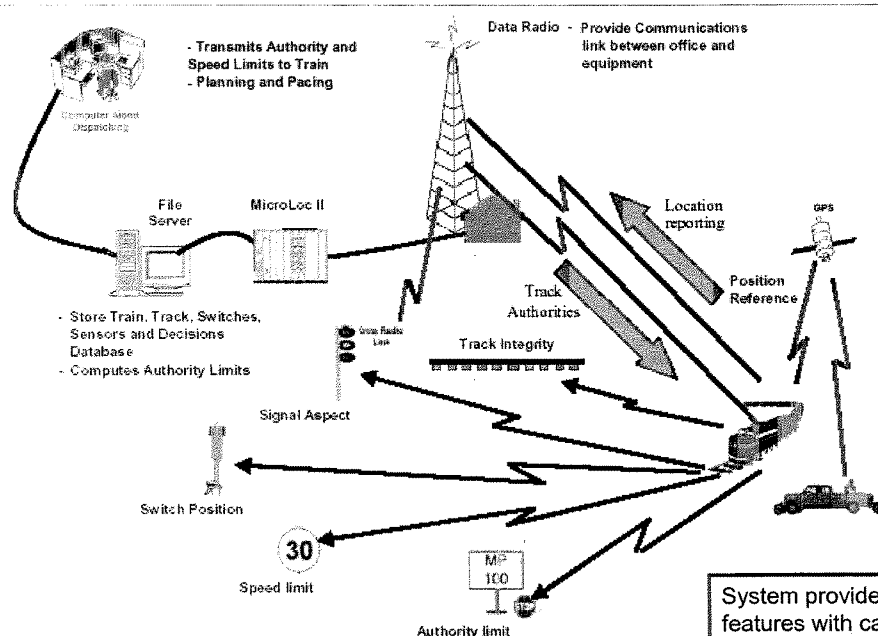
Positive Train Control provides next generation safety and business benefits

Alaska Collision Avoidance System

- Implementation in progress on the Alaska Railroad
- System design will:
  - Prevent train-to-train collisions by enforcement of train movement authority limits (territory over which train is authorized to travel)
  - Increase overall capacity
  - Utilize on-board equipment to
    - Enforce speed restrictions
    - Enforce movement authorities
  - Improve operational efficiency
  - Automatically generate and digitally transmit track authorities and speed restrictions
  - Provide protection to right-of-way workers and their equipment
- Designed as a closed-loop safety system (vital – every failure results in a safe outcome)
- Utilizes proven technology components
- Advanced control features provide additional business benefits

Safety & Security Enhancement

Alaska System Overview



System provides baseline features with capability for expansion

April 28, 2005

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5

Automated train stop improves overall safety level

New Jersey Transit - Advanced Speed Enforcement System (ASES)

- Provides improved level of safety – ensures trains STOP at red signals
- Monitors train speed, automatically enforces civil speed limits and signal aspects
- Provides for temporary speed enforcement during railroad infrastructure improvements
- Can be applied in any territory
- Can be deployed as an overlay to existing signaling systems
- Ideally suited to application in mixed traffic applications
- Does not restrict operations due to use of latest train profile braking calculations for optimized braking of all train types
- Can be applied to any existing or new locomotive or train type
- Utilizes proven European technology

Safety Enhancement

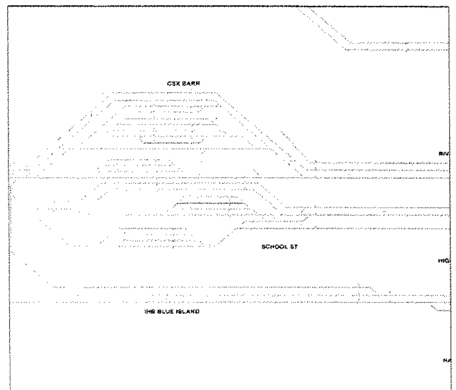
Integrated rail operations system provides base for immediate congestion mitigation in metropolitan areas

Common Operational Picture

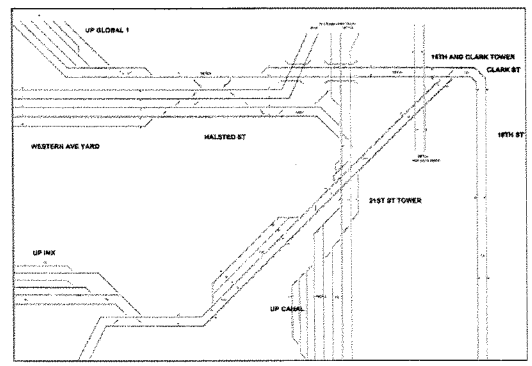
- Allows railroads to reduce congestion in multiple railroad, heavily trafficked areas or chokepoints through improved situational awareness
  - Application in areas such as Chicago, New Orleans, Kansas City, Los Angeles, Northeast region
- Significant positive impact on freight/commuter and passenger rail operational efficiency and their customers
- Provides combined, real-time *seamless* overview track diagrams of *all* the railroads' tracks, devices and trains in heavily trafficked areas and major interchange points
  - Overview enables multiple railroads to *coordinate* train moves for *increased throughput (currently done by voice or paper communication)*
- Viewable by authorized personnel on large fixed panel displays, laptops, or handhelds
  - Requires only an internet connection and web browser
  - Security features protect information from unauthorized use

Facilitates Better Rail Operations Co-ordination

Consolidated overview rail screens provide a leap in rail/passenger operational efficiencies



Traditional View: each railroad only sees their own territory in line diagram.



Consolidated View with Common Operational Picture: railroad personnel see all railroads in a geographical view.

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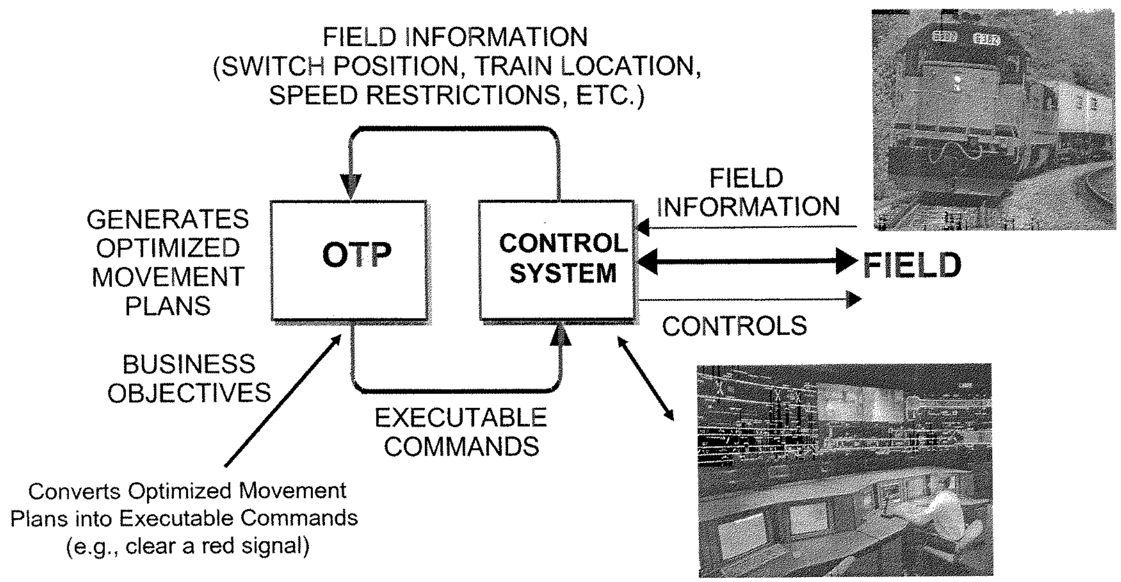
Optimizing Traffic Planner provides technology to improve railroad, commuter and passenger train operational efficiency without infrastructure investment

Optimizing Traffic Planner

- Next generation railroad operations planning system
- Allows railroads to handle the increased freight traffic demands of the future
- Complementary to mixed freight, commuter and passenger rail operations to improve on time performance and reduce congestion
- Optimizes to railroad business objectives such as 'Maximizing Average Velocity of all Trains'
  - Has been demonstrated to increase a Class 1 railroad's average train velocity between 3 and 6 mph
- Increases capacity utilization of existing rail infrastructure
  - Will help alleviate rail transportation infrastructure crisis
  - Will enable high-speed trains to run across existing lines without affecting freight performance
- Improves on-time performance of both passenger and freight trains

Key to Growth of Freight and Passenger Rail Traffic

Rail Optimizing Traffic Planner



Train Dispatchers Interface to Control System

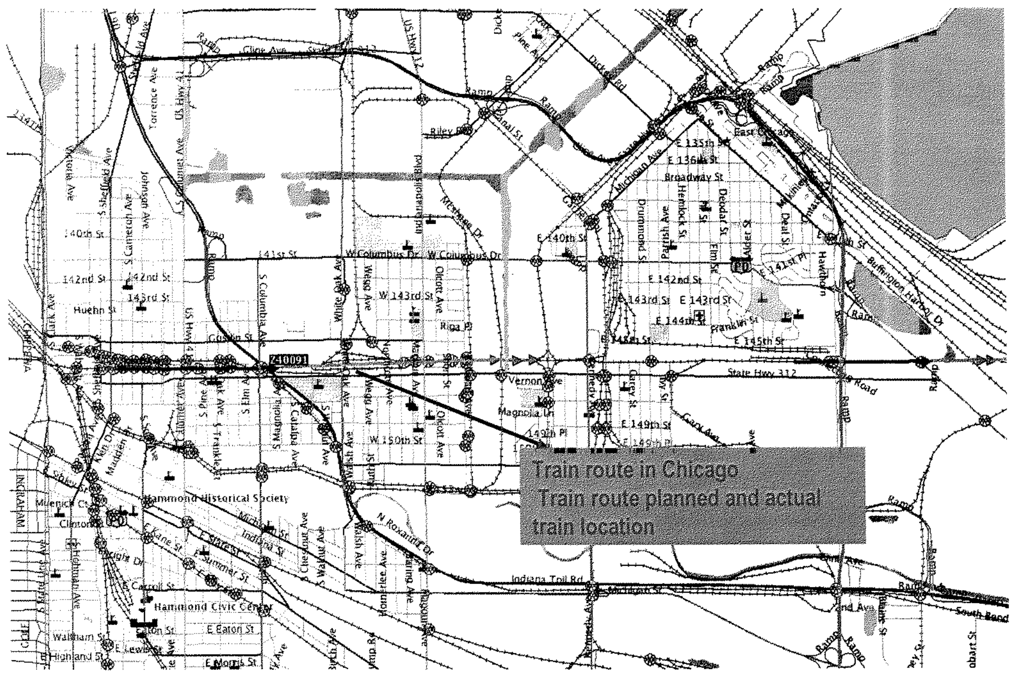
Rail public safety advisory tool

Civil Advisor System

- Centralized monitoring providing real time train location and track information on a Geographical Information System (GIS)
- GIS provides:
  - detailed rail line information with highway/street location, location of major landmarks, weather, points of interest such as stadiums, convention centers, hospitals, etc.
- Integrates railroad operational information for display of train position, device activity and other information of high interest
- Conceived to display real time train position and activity with respect to highway crossings for 911 dispatchers
  - active crossing warning status, display blocked crossings and train position, projected routes
- Can be expanded to display other pertinent information
  - Train manifest, Hazardous Material (HAZMAT)
- Users
  - Freight Railroads/Transit Agencies
    - Dispatchers, Police, Transportation, MOW, Engineering, Mechanical, Customer Service
  - Town, city, county Public Safety Answering Points (PSAP's)
  - Federal and State Government
    - Department of Homeland Security, Transportation Security Administration, Department of Defense, FEMA

Enhanced Rail/Public Safety Co-ordination

Civil Advisor System Sample Screen



Congress of the United States
Washington, DC 20515

Opening Statement for the Honorable Eddie Bernice Johnson
House Subcommittee on Railroads
"New Technologies in Railroad Safety and Security"
Thursday, April 28, 2005 – 2167 RHOB

Thank you Mr. Chairman.

I want to thank you and Ranking Member Brown for holding this important hearing this morning.

As we all know, our nation's transportation system is the backbone of our economy and way of life.

Every day, various modes within our nation's transportation system transports millions of people and tons of goods throughout the country.

Critically important to this equation is the role of secure freight and passenger rail systems.

While the tragic events of September 11th, 2001 have forced us to take a hard look at how we secure our various modes of transportation—rail security remains a significant challenge.

According to GAO, a number of positive steps have been taken by rail stakeholders to bolster the nation's rail security since September 11th such as: performing risk assessments, emergency drills, and developing security plans.

However, one only needs to turn on the news, or pick up a local newspaper to realize that our nation's rail systems still remain extremely vulnerable to the possibility of terrorist attacks that could jeopardize countless lives and spawn serious economic disruption.

For example, on June 28th of last year, two freight trains carrying chlorine gas collided in my state killing three people. Only one of the dead was aboard. The others died as a result of gas drifting over a residential neighborhood over a mile away.

Furthermore, we must never forget the horrific, Madrid train bombings last year that left two-hundred commuters dead and fifteen-hundred wounded.

These incidents and countless others highlight the unique challenges and risk associated with rail systems.

While I am heartened by GAO's findings—more work remains to be done, particularly in resources invested towards surface transportation concerns.

I feel strongly that, as policymakers, we must revive our resolve to approach rail security challenges with a sense of urgency. To do otherwise only serves to further compromise the safety of the American public.

According to the Mineta Institute, globally, surface transportation systems were the target of more than one-hundred ninety five terrorist attacks from 1997 through the year 2000.

As I close, I want to thank our witnesses that have come before us to testify this morning.

I look forward to their testimony, as I am particularly interested in learning more about the latest security innovations; the level of coordination amongst rail stakeholders; and what we as a body may do to further assist them to help bolster freight and passenger security efforts.

Thank you Mr. Chairman.

Statement of Congressman Robert Menendez
At the Rail Subcommittee Hearing on
"New Technologies in Railroad Safety and Security"
April 28, 2005

Thank you very much, Mr. Chairman, and thank you for holding this hearing. I'm happy to be able to sit in for our distinguished ranking member who is unavoidably detained. However, I'm not terribly happy about the status of rail safety and security in this country. I know our witnesses are here today to talk about new technologies that will make our trains safer and more secure, and I'm looking forward to hearing what they have to say.

But I would also like to see this subcommittee hold a hearing on rail safety oversight, particularly in light of a number of recent accidents and the series of Pulitzer Prize-winning articles in the New York Times last year regarding the cozy relationship between the Federal Railroad Administration and Union Pacific. An Inspector General report from December brought to light a number of disturbing questions about FRA's regulatory oversight process, and whether that process is sufficient to ensure public safety. I think this subcommittee is exactly the right place to address that, but I think we're long overdue, since we haven't had a true rail safety oversight hearing in almost three years.

However, that is for another day. Today we are here to discuss how technology can better protect the people that work, ride, or live alongside our nation's railways. This is an extremely important issue for me, since my District is tightly packed with freight and passenger rail lines, including the Northeast Corridor. If you add in subways, light rail, and commuter railroads, there are millions of people on the rails every day in this country, and we have not been spending nearly enough to ensure their safety.

That's why I introduced the Rail and Public Transportation Security Act earlier this year, which provides over 10 billion dollars to address critical operating and capital needs for Amtrak, freight rail, and public transportation security, including 300 million dollars for research, development, and field testing of new technologies. In addition, my bill includes a welded rail and tank car safety improvement program that was developed in response to the derailment in Minot. The recent tragedy in South Carolina also shows us how seriously we need to take tank car safety, and how we have to make a serious federal commitment in order to protect people from both accidental and malicious disasters.

I am amazed that the federal government hasn't made this investment already. Rail systems are extremely vulnerable to terrorist attack, as shown by last year's attacks

in Madrid. In fact, since 9/11, there have been over five times as many attacks on public transportation targets than on airplanes.

I have asked my colleagues to imagine what we would have done, what action we would have taken, if the Madrid train bombings had occurred in our homeland, on our soil. What immediate investments would we have been ready to make? What urgent action would we have been willing to take? The new technologies we will hear about today are a first step towards taking that action, but we need to do more, and we need to do it now.

I thank the witnesses for being here today, and I look forward to hearing your testimony.

STATEMENT OF
THE HONORABLE JAMES L. OBERSTAR
SUBCOMMITTEE ON RAILROADS
HEARING ON
"NEW TECHNOLOGIES IN RAIL SAFETY AND SECURITY"
APRIL 28, 2005 – 10:00 AM

I want to begin by thanking Chairman LaTourette and Ranking Member Brown for holding this hearing on new technologies in rail safety and security.

It is important for Congress to explore new technologies that are available to improve rail safety and security. But I believe we should go further and explore all issues surrounding rail safety—not just those issues relating to new technologies. The number of rail accidents is increasing. According to the Federal Railroad Administration (FRA), there were 3,127 rail accidents in 2004, up from 2,993 accidents in 2003 and 2,738 accidents in 2002. And the first week of 2005 (January 6, 2005) saw the catastrophic accident in Graniteville, ~~North~~ South Carolina. NTSB investigators found that the Graniteville accident occurred as a result of improperly lined switches. According to the Department of Transportation's Inspector General, trend analysis of rail safety data identifies improperly lined switches as the second-largest cause of railroad accidents and the leading cause of accidents resulting from human error.

My concerns about FRA's rail safety and the enforcement program were confirmed in the DOT's Inspector General's February 16, 2005 report entitled *FRA Safety-Related Findings and Recommendations*, in which safety and enforcement data show that serious safety problems have long persisted for all four major railroads, despite a significant increase in civil penalties FRA has assessed the railroads. In addition, the Inspector General highlighted a number of prior audit report recommendations that the FRA has failed to implement. For example, the Inspector General's 2002 recommendation that the FRA make greater use of inspection results developed in the Safety Assurance and Compliance Program process to better focus inspection and enforcement efforts on safety concerns that are most likely to result in accidents and injuries.

Mr. Chairman, this Subcommittee has not held a hearing on train derailments and rail safety since June 6, 2002 – about three years ago. I hope that this Subcommittee under your leadership will take a closer look at these issues.

Regarding the issue of new technologies in rail safety, this hearing is timely. I met with Bombardier Transportation this week regarding Amtrak's Acela Express service, which was suspended on April 15th because a routine maintenance inspection of an Acela train uncovered cracks in the spokes of the train's disc brake rotors. This led to an investigation of the brake rotors on all 20 Acela trainsets, prompting

Bombardier and Alstom, which manufactured the Acela train and maintains Amtrak's trainsets, to consider new designs and new technologies for retrofitting the Acela fleet.

Some have speculated that the added weight of Acela trains required by FRA regulations caused the problems that Bombardier, Alstom, and Amtrak have experienced with the Acela's speed, brakes, wheels, and shock-absorbing assemblies. I'd like to hear the FRA's views on this.

Other technologies are critical to the development of high-speed rail service. For example, Positive Train Control (PTC) utilizes intelligent transportation technologies including onboard computers, digital radio links, differential global positioning systems, computer route databases, and wayside computer control systems to assure that train operations are safe.

I'm eager to get an update from the FRA and the Association of American Railroads on the status of the North American Joint Positive Train Control Program. The primary objective of this project is to demonstrate a cost-effective PTC system on a 120-mile segment of the Chicago-to-St. Louis high-speed rail passenger corridor. This project, which has become a national test-bed for PTC, is expected to deliver a

communications-based wireless train control system that can readily and inexpensively be extended over the remainder of the corridor and to other rail corridors nationwide.

Unfortunately, the railroads have stated in the past that PTC is too expensive. Some railroads have advanced an alternative approach that they claim captures most of the benefits at significantly less cost. However, my expectation is that whatever interim steps might be taken, we do not abandon the goal of widespread implementation of PTC.

Thank you, Mr. Chairman. I look forward to hearing from our witnesses.

April 28, 2005

U.S. HOUSEOF REPRESENTATIVES
COMMITTEE ON TRANSPORTATION and INFRASTRUCTURE
SUBCOMMITTEE ON RAILROADS

HEARING ON NEW TECHNOLOGIES

TESTIMONY OF W. DAN PICKETT
INTERNATIONAL PRESIDENT
BROTHERHOOD OF RAILROAD SIGNALMEN

Good Morning. Mr. Chairman and members of the Committee. It is an honor for me to testify today on new technologies for rail safety, a subject of great concern to this country and to all employees of the nation's railroads.

My name is Dan Pickett, and I am the International President of the Brotherhood of Railroad Signalmen. The Brotherhood of Railroad Signalmen ("BRS"), a labor organization with headquarters at 917 Shenandoah Shores Road, Front Royal, Virginia, 22630-6418, submits the following comments concerning new technologies in the rail industry.

BRS, founded in 1901, represents approximately 9,000 members working for railroads across the United States and Canada. Signalmen install, maintain and repair the signal systems that railroads utilize to direct train movements. Signalmen also install and maintain the grade crossing signal systems used at highway-railroad intersections, which play a vital role in ensuring the safety of highway travelers. Throughout our entire existence, the BRS has dedicated itself to making the railroad workplace safer, not just for rail workers, but also for the public at large.

Before any discussion of new technologies for rail safety can even begin, it should be noted that the rail industry is moving more freight with less employees than at any time in the history of railroading. This is a critical point that must be acknowledged. Through mergers and railroad managements' never ending quest to eliminate workers, railroad staffing levels are at an all time low and continue to drop. Those railroad employees that are left are working longer hours for many days at a stretch. A 12 to 16 hour day is not unusual for a railroad worker and in many cases it is the norm. Railroads are abusing the very asset that is their most important resource that secures their property day in and day out.

The railroads need to start treating front-line employees as true partners in the effort to protect our rail system – these workers are the "eyes and ears" so to speak of the industry. They greet passengers, sell tickets, operate trains, maintain track and signal systems, dispatch trains and repair rail cars. In today's volatile climate, rail employees are always wary of a possible terrorist attack and in the event that an attack does occur, our members will be on the scene and the first to respond along with firefighters and police.

The inability to perform adequate testing and the failure to comply with minimum federal regulations have contributed, if not caused many recent railroad accidents. In their never ending zeal to focus on the financial bottom line, railroads have allowed staffing levels to fall below the minimum needed to perform basic safety functions. Additionally the railroads are not through with their desire to further reduce manpower levels. The railroads are currently pushing very hard to reduce train crew size to a single person, and the implementation of Remote-Control-Locomotives (RCL) is proliferating as I speak here today.

Railroad management appears convinced that RCL operation is safe and a worthwhile pursuit. Yet accidents, derailments, and fatalities are occurring at an alarming rate when RCL is utilized. The use of unregulated RCL's remains both a safety and security issue that needs to be resolved. New technology offers many opportunities; however, before implementing new technologies, as much effort that went into the design of these devices, should also be put forth in studying the possible risks to workers who operate this equipment.

Positive Train Control:

On March 7, 2005 the Federal Railroad Administration (FRA) issued the Final Rule for 49 CFR Parts 209, 234, and 236, Standards for Development and Use of Processor-Based Signal and Train Control Systems.

With this Final Rule, FRA is issuing a performance standard for the development and use of processor-based signal and train control systems. The rule also covers systems which interact with highway-rail grade crossing warning systems. The rule establishes requirements for notifying FRA prior to installation and for training and recordkeeping. FRA issued these standards to promote the safe operation of trains on railroads using processor-based signal and train control equipment.

It is the position of rail labor that with adequate investment and proper planning, PTC systems can be built to serve the needs of the general freight rail system as well as inter-city and commuter passenger railroads.

While PTC systems configured for the general rail system are not available currently "off-the-shelf," planning and development are underway to produce such systems. The systems being envisioned will likely utilize: the Global Positioning System (GPS) with differential augmentation as the foundation, but not sole input, of its train location system; data-link radio as a principal communications medium between trains and controlling computers; on-board computers; and wayside interface units to relay information available in the field to controlling computers, among other features.

In order to ensure the safety of the railroad industry, especially when taking into account possible terrorist attacks, it is of the utmost importance to secure the funding for this worthwhile endeavor. We need to provide funding for the infrastructure to ensure that these systems are implemented and that we can therefore reap the much needed safety benefits.

The nation's rail industry can realize the greatest safety benefits by utilizing PTC systems in conjunction with the existing signal systems. Current signal circuits provide fail-safe "vitality" while PTC provides what its name implies, positive train control/separation.

It should be noted that these new technologies will not cure all that is wrong in the rail industry. Positive Train Control and the next generation signal systems are but tools to improve and enhance safety and security across the nation's railroads. However, they are not the end all and they are not in their present form fail-safe or even remotely infallible. It will take their implementation and the concerted efforts of the maintenance of way worker who installs the track, the dispatcher who controls the train movements, the signalman who provides clear signals, to the engineer who drives the train, to provide increased safety and security on our nation's railroads.

Improved Railroad Signal Systems:

Before I can speak on improved signal systems I must talk about current signal systems. Signal systems utilize a fail-safe design. They incorporate track circuits where the rails of the track form the foundation of the system. Existing signal systems currently in use today are designed to protect the safety and integrity of the railroad's operations on a section of track, providing protection from broken rails, track defects, track obstructions, and ensuring proper switch and derail alignment, route integrity, and protect against collisions and derailments. Many such systems use wayside signals to convey signal aspects and indications to train crews. Furthermore, signal systems are designed to mitigate the dangers caused by human error or acts of vandalism or terrorism. While signal systems are vital to the safety of the railroad's operations, it is also critical to the protection of residents of the communities adjacent to the affected portion of track.

Because of the known safety benefits of present-day signal systems it is imperative that these systems are properly maintained and remain in operation. However many railroads have petitioned the FRA through the Block Signal Application provisions of current regulations to remove signal systems and convert their method of operations to Dark Territory using Direct Traffic Control (DTC).

What is Dark Territory? In the railroad industry there are basically two methods of operation for moving trains. There is signaled territory and non-signaled territory. Non-signaled territory is also known as Dark Territory. Generally, in Dark Territory a train dispatcher authorizes the movement of trains to enter various portions of track on a railroad. The engineers who drive the trains then are governed by a set of operating rules to proceed through the authorized area. There are no checks and balances and the method of operation is heavily reliant on the human element to control the movement of trains. Dark Territory also increases the train dispatcher's work load, thereby degrading safety by introducing additional human factor risks to the area.

Rail labor opposes elimination of signal systems because of the well-established safety benefits afforded by these types of signal operation. Clearly, it is in the best interest of the local residents to have the assurance of rail operations based on the protection provided by a signal system.

A good example of the benefits of a signal system can be seen when we look back at the January 6, 2005 derailment and hazardous materials release in Graniteville, South Carolina, which preliminary investigation has indicated was a result of an improperly lined switch. Nine people died, 318 needed medical attention and 5,400 residents within a one-mile radius of the crash site were forced to evacuate. According to the Naval Research Lab, a similar incident in a major urban metropolitan area would have resulted in 100,000 deaths.

The segment of track where the accident occurred was Dark Territory and the method of operation was Direct Traffic Control. A basic signal system would have prevented this accident. A switch monitoring device would have noted that the hand-throw switch was not properly lined and the train would have had a red signal. A red signal is a stop indication for a train.

As I stated previously, signal systems are designed to mitigate the dangers caused by human error or acts of vandalism. In the case of human error, if the hand-throw switch was left in the wrong position, the signal would not have gone to green, or "cleared" for the next train. The signal would have been red and indicated to the train crew to stop. In the case of a malicious act or vandalism, when switches are tampered with or purposely lined for the wrong track, once again the switch monitoring device would indicate that the switch was out of alignment, and as a result, caused the signal to be red or "at stop."

Oftentimes, railroads do not invest in the maintenance and repairs of their current signal systems. Then after experiencing normal weather conditions for the area, i.e.,

snowstorms, ice storms, high winds, etc., they often assert in their waiver applications, that the expenses associated with repairing such systems is justification to allow the waiver to be granted. Another reason they use is that replacement parts are no longer available. Rail labor contends that the reasons given by railroads are not valid. All equipment utilized in the railroad industry at some point approaches the end of its useful life. That is why equipment is constantly maintained, repaired and replaced at the proper intervals. Improper planning by the railroads and their failure to properly maintain the signal systems are not reasons to grant a waiver request and increase the amount of Dark Territory.

The technology changes envisioned for railroad signal systems is underway as I speak. Positive Train Control systems are just one facet of the signaling revolution that is occurring. Many current signal systems benefit from changing technology. As the President of the Brotherhood of Railroad Signalmen my organization has seen technological changes that were unthinkable 100 years ago. We have seen the simple signal light go from oil-lit to incandescent to a light emitting diode. We have seen crossing protection go from flagmen to air-operated gate men to D.C. track circuit detection to solid state motion detectors. My organization and all of rail labor have welcomed and adapted to the technological changes. We have embraced the advancements of the past and we look forward to future technologies because we believe that they will improve the work environment and make a safer and more reliable rail system.

However, along with that new technology comes new problems. We must be forever diligent to ensure that any new technology that the railroad industry contemplates to implement that we also perform the proper risk analysis and take the proper steps to make sure that we have not introduced more new hazards than we eliminated.

Training and Education:

Training and education is another key preventive measure that needs to be considered. Rail labor considers it equally important to provide Advanced Training to improve the skills of the professional men and women that install and maintain safety systems for the rail industry. This is an area that will improve safety. Rail labor continues to work to implement training provisions which were agreed to by the industry – but to date have not been implemented on many of our nation's railroads.

In addition to craft specific training, security training must be mandated. While some rail carriers might claim progress in this area, I have talked to too many workers who are not receiving any training or might be allowed to watch a one-size fits all video. This is woefully inadequate. Workers need to know how to identify a security risk and what to do in that situation. When should passengers be evacuated? Who is the contact person to report a potential risk? What actions, if any, should a worker take in a given situation? How should trains, stations or tunnels be evacuated and handled in different situations? What are the appropriate and necessary communications protocols crewmembers should follow in the event of a security breach or incident? These are just a

few of the many questions we know that workers are asking and not getting sufficient answers to. In addition to formal training, technology must be provided to allow train operators to alert dispatchers and management of security developments that may arise during operations.

As you know, the railroads transport the most toxic and dangerous materials in the country such as poisons, explosives, and flammable gases. The train crews are usually aware of which trains carry hazardous commodities, but that is little protection in preventing a catastrophe. Most freight trains in the United States transport some hazardous materials. The train crews are given very limited training in understanding what to do in case of a hazardous material leak or explosion. Basically, the instructions are to leave the scene and allow local emergency personnel to deal with the matter. That kind of action is totally insufficient when a terrorist attack occurs. It is too late to save lives after the train has been targeted. The risk to the public and the train crews are too extraordinary not to have knowledgeable, well trained crews to deal with safety and security.

After 9/11 each railroad was required to develop and implement security plans. The Transportation Security Administration (TSA) has apparently approved the plans of most railroads. The problem is that the plan is a secret between the railroads, the Department of Transportation (DOT) and the TSA. The employees have not been brought in the loop. The bottom line is that the TSA and the railroads must promptly begin an intense training program to educate and prepare railroad employees to recognize potential terrorists and safety/security risks in the vicinity of railroad facilities, and instruct the workers on the appropriate action to take in case of an attempt to target a train. If it is not done voluntarily then Congress should mandate the necessary training.

A companion issue with training is one of certification. In order to ensure accountability for the safe operation and maintenance of railroad equipment and facilities, the industry needs to create a certification program for personnel with safety responsibilities that would include engineers, carmen, mechanics, signalmen and track inspectors.

Enhance Rail Safety Enforcement

In addition to training, we must also ensure that workers who report or identify a security risk will not face retribution or retaliation from their employers. Simply put, a rail worker should not have to choose between doing the right thing on security and his or her job. Unfortunately, too often this is exactly what occurs in the industry when it comes to workers reporting rail safety risks and concerns.

Rail workers and their unions have long argued that despite the whistle-blower protections included in current law (49 U.S.C. § 20109), employees still experience employer harassment and intimidation when reporting accidents, injuries and other safety concerns.

If Congress considers rail security legislation, it must address this problem by strengthening the current whistle-blower protections and ensuring that workers who report security concerns are covered by the strongest possible protections. Everyday, rail carriers and the government ask front-line workers to be more vigilant about security risks and to report possible breaches. With the right training, rail workers are more than happy to play this role. But it is disingenuous to ask workers to report problems and at the same time refuse to give them the basic protections needed to ensure that such reporting will not result in retribution from their employer. Again, I urge the Committee to send a clear message on this point – workers are to be treated as partners in enhancing security, not critics to be silenced. In fact, I would like to see railroad workers eligible for the same whistle-blower protections in the Sarbanes-Oxley Act. Surely, if we can protect whistle-blowers who report financial security problems, we can also protect those who report rail safety concerns.

Improved Infrastructure Inspection and Security Technologies:

Over three and one half years have passed since the horrific events of 9/11, yet amazingly too little has been done to secure our nation's transportation network from another terrorist attack. Sufficient resources have not been allocated, common-sense requirements have not been imposed, and too often employees and their unions have not been enlisted as true partners in the process. While we understand that our vast transportation network can never be made immune from attack, in many respects our government has abdicated its responsibility to protect the homeland from security threats. More can, and must be done to secure targets and protect passengers, employees and communities.

America's transit and rail systems continue to face terrorist threats due to government inaction and neglect. The transit industry alone has identified \$5.2 billion it needs in federal security-related capital investment over the next three years and \$800 million annually for ongoing operating and maintenance expenditure – a total of \$7.6 billion over three years or about \$2.5 billion annually. By comparison, the President did not allocate any serious resources for transit and rail security and Congress approved just \$150 million in security grants for FY 2005. This is supposed to cover security needs for intercity passenger rail, freight rail and transit. Put another way, over the past three years, the federal government's security assistance is 30 times less than the industry's currently projected three year need.

Amtrak requires \$110 million in one-time security upgrades, \$10 to \$12 million annually for on-going security costs and approximately \$650 million for its fire and life-safety program along the Northeast Corridor. The Bush Administration wants to zero-out Amtrak, submerge it into bankruptcy, and force states to pick up the tab – a scheme that would result in the destruction of our national passenger rail system and expose rail passengers, workers and the nation to untold security threats. Congress must reject this reckless proposal by the Administration.

When discussing security technology, one of the most important issues concerns information technology systems utilized for signal systems. Rail labor believes that it is important to know how and where signal system information backed up? Present operations of the major railroads are consolidated to one dispatching location. Most dispatch centers contain all of the signal control information. If a center was disabled or lost forever what safeguards are in place to get the system up and running as soon as possible? Additionally, are the operating systems backed up offsite? These are just some of basic concerns that have to be addressed in order to keep the nation's railroads up and running in the event of a catastrophe, either man-made or natural.

One of the easiest ways to improve infrastructure inspection is to amend 49 U.S.C. §20142 to direct the Secretary to issue rules requiring that no visual track inspection be conducted from a vehicle traveling at a speed of more than 15 miles per hour. Speed is a factor for both security and safety. At lower speeds the track inspector can do a better inspection and is also more likely to observe an individual with intent to harm railroad property be it either a common vandal or terrorist.

It is equally important to make provisions requiring all track motor vehicles, self-propelled maintenance of way equipment, and other equipment which is designed with permanent or retractable flanged wheels, to be designed and maintained so as to conduct electrical current from one rail of the track to the other. This will activate signal systems designed to detect the presence of locomotives, cars, trains, and other rolling equipment on the track. The purpose of this recommendation is twofold: you get a better inspection at a lower speed and by shunting the track you activate the grade crossing signal systems designed to protect the traveling public.

Current regulations call for a minimum of two track inspections a week. If you increase the inspections to more than two times a week, the visibility of the inspectors, or put another way, the higher profile of people on the track will discourage undesirables and make it more difficult for anyone planning to create havoc on the railroads.

Better Emergency Planning and Coordination

Rail labor believes that the incorporation of a nationwide telephone notification system would greatly improve safety for our nation's grade crossing signal systems. Rail labor has long recommended that a nationwide telephone reporting system, such as a 1-800 system, be developed to allow members of the public to report crossing signal malfunctions. Although FRA has made this a recommendation, it is not presently required by regulation. As such, while many Class I railroads have voluntarily implemented some type of 1-800 notification system, most Class II, Class III, and/or short line railroads have not. This nationwide telephone notification system could also be used by anyone to report derailments or other events that affect safety and security on railroad property.

Modern Passenger Coach Technologies:

Their have been many improvements to modern passenger coach technologies and in fact many of the recommendations contained in the *Locomotive Crashworthiness &*

Working Conditions report are currently being implemented. Also at this time the FRA Railroad Safety Advisory Committee (RSAC) has currently authorized a subcommittee entitled the Passenger Safety Working group. They are currently exploring a myriad of ways to make the passenger coaches safer. I defer my time on this topic to the FRA Administrator.

At this time I would like to state for the record that there are many low-tech avenues to pursue when it comes to passenger safety. Rail labor has recommended that an in-depth study should be performed for rail passenger safety. The study should consider but not be limited to: Photo ID's to board trains; Metal detectors; Security questions of passengers; Luggage checked or kept with passenger; and No movement between passenger train cars. It is the position of the rail labor that this would be a good first step in making rail travel safer for the traveling public.

Conclusion

There is little question that more must be done to improve rail security – both in the transport of passengers and freight. While we all agree with this statement, it all comes down to money. The Transportation Security Administration (TSA) is spending $4.4 billion this year on aviation security – an investment in aviation security we of course support – but passenger rail and transit are being left with just $10 million. When you acknowledge the size and scope of our rail system and infrastructure, this lack of attention and focus is hard to understand. There are over 100,000 miles of rail in the United States – 22,000 miles of it used by Amtrak in 46 states and the District of Columbia. Amtrak served approximately 23.4 million passengers in the past year, or 64,000 a day. Commuter rail operations add 1.2 million passenger trips each weekday. The freight rail carriers transport 42 percent of our nation's domestic intercity freight.

So our rail security challenge, based just on the size of the system, is indeed daunting. In addition, we must recognize that given the open nature of our rail transportation network, we are never going to be able to secure it entirely, as it is, unlike aviation, railroads are simply not housed in a closed or controlled infrastructure.

While just as there is no silver bullet in medicine to cure all ills, new technologies will not cure all that is wrong in the rail industry. Positive Train Control, solid-state grade crossing signal systems, next generation signal systems, these are but tools to improve and enhance safety and security across the nation's railroads. However, they are not the end all and they are not in their present form fail-safe or even remotely infallible. It will take their implementation and the concerted efforts of the maintenance of way worker who installs the track, the dispatcher who controls the train movements, the signalman who provides clear signals, to the engineer who drives the train, to provide increased safety and security on our nation's railroads.

There is much to accomplish to make the nation's railroads safer for communities across the country and for the employees. Experience teaches us that it is Congress that

must provide the leadership to make safety a reality. I hope we can work together to see that improved safety practices become a reality.

On behalf of rail labor I appreciate this opportunity to testify before the Committee. At this time I would be more that pleased to answer any questions.

Respectfully submitted,

W. Dan Pickett

W. Dan Pickett
International President

Testimony of Thomas G. Rader
President, Colorado Railcar

Before the Subcommittee on Railroads

April 28, 2005

Testimony of Thomas G. Rader, President, Colorado Railcar, before the Subcommittee on Railroads, April 28, 2005.

Mr. Chairman, thank you for the invitation to discuss with your committee today the significance of new technological developments in the U.S. passenger railcar industry. My focus will be on commuter and intercity passenger railcar developments.

Two developments are showing the potential to substantially reduce the cost of commuter and intercity rail.

THE DMU

The first is the U.S. development of the self-propelled railcar, or as it is known in the trade, the Diesel Multiple Unit (DMU). This is a passenger carrying railcar with diesel propulsion engines underneath the floor. Thus, no locomotive is required. It propels itself and is often powerful enough to pull another non-powered passenger coach.

Multiples of these DMUs can be coupled together into trainsets of varying sizes to fit ridership demands. Thus, they are known as Diesel Multiple Units. The DMU is widely used throughout Europe and the rest of the world. In the U.S. it was used extensively until about 35 years ago under the name Rail Diesel Car (RDC).

THE DOUBLE DECK PASSENGER RAILCAR

The second is the development of the double deck passenger railcar. The double deck railcar is distinct from the so-called bi-level or multi-level railcar that has evolved in many forms over the past 60 years.

The double deck railcar has two full floors over the entire length of the railcar. By contrast, the bi-level or multi-level car has two floors only between trucks, and only one floor over the trucks where headroom would not permit two floors. Thus the double deck car has much more passenger floor space in the same length of railcar.

These two technological advances, the development of the modern U.S. DMU and the development of the double deck passenger railcar, offer most of the same benefits to the user. However, because the benefits of the DMU are so much more dramatic, we will focus much of our attention on the DMU. Of course, the most significant user benefits are realized when you combine the benefits of both technologies in the development of a double deck DMU.

THE REGULATORY ENVIRONMENT

Within the last six years, the Federal Railroad Administration (FRA) and the American Public Transportation Association (APTA) have promulgated a series of new regulations and standards for the strength and safety of passenger railcars operating in the national rail system. These regulations have caused passenger railcar manufacturers to redesign and reengineer their railcars to make them stronger and safer for the traveling public.

Although rail travel is already one of the safest modes of travel, recent incidents have once again underscored the wisdom of these new regulations and standards.

At the same time, rising fuel and maintenance costs of traditional locomotive hauled passenger trains have encouraged the redevelopment and modernization of the self-propelled passenger railcar. This updating of the historic Budd Company rail diesel car into the modern U.S. DMU was hampered by the requirement to meet the new regulations and standards. Because U.S. standards are substantially higher than those of the foreign manufacturers, no one wanted to develop a modern rail diesel car to U.S. standards until they could be assured of a large and profitable order. However, no U.S. rail transport agency was willing to place a large speculative order for a new and untried car.

This stalemate meant that the benefits of the modernized rail diesel car were realized in Europe, where the standards of strength are lower, but the order quantities are higher. Those benefits are so substantial that literally thousands of these railcars are operated throughout Europe and the rest of the world.

When we study the benefits of the DMU, it becomes obvious why they are so popular in Europe and elsewhere. When we compare the operation of DMU trains to traditional locomotive hauled trains (in applications where DMUs are appropriate) using data from U.S. transit agencies we get some significant results that are quite relevant to the subject of today's hearing.

- **50 % REDUCTION IN FUEL CONSUMPTION**
- **68 % REDUCTION IN EMISSIONS**
- **75 % REDUCTION IN NOISE**
- **OPERATING COST REDUCTIONS OVER ITS 30 YEAR LIFE EQUAL TO TWO OR THREE TIMES THE CAPITAL COST OF THE DMU**
- **REDUNDANT SYSTEMS DESIGNED FOR INCREASED RELIABILTY & SAFETY**
- **SUBSTANTIALLY REDUCED CAPITAL COSTS FOR STATIONS, PARKING TRACKS & MAINTENANCE FACILITES**
- **NO INCREASE IN INITIAL TOTAL CAPITAL COST TO ACHIEVE THESE BENEFITS**

Therefore, the development of this technology and the manufacture of DMUs in the U.S., to U.S. standards, addresses many issues of importance to this committee and to the U.S. citizenry as a whole.

CONTRIBUTE TO ENERGY SECURITY

By reducing the fuel consumption per passenger mile by 50% or more, the DMU technology could save millions of gallons of fuel per year for rail operators. This is a conservation measure whose capital cost is repaid through fuel cost savings. This is a significant source of fuel conservation that will help to reduce our dependence on imports of foreign oil.

CONTRIBUTE TO IMPROVED AIR QUALITY
By reducing engine exhaust emission by 68% or more per passenger mile, the DMU technology could save thousands of pounds of emissions from entering our atmosphere. And not just coincidentally, rail systems where DMUs shows the greatest potential returns are concentrated in many of our non-attainment or near non-attainment areas.

DEVELOP U.S. TECHNOLOGICAL KNOW-HOW
The principal reason that we had not enjoyed the benefits of DMUs in the U.S. was that there were no U.S. owned manufacturers with the incentive to develop advanced cars for the nascent U.S. market. In fact, foreign manufacturers brought their non-compliant railcars to the U.S., demonstrated them and then explained that the U.S. just needed to change its standards of strength and safety so that their non-compliant cars could be operated here. This campaign continues to this day.

Therefore, the development of the technological know-how in the U.S. will assure us that we will never again be deprived of the ability to develop uniquely American products that serve to benefit the American people.

In 2002 my company invested the millions of dollars required to develop this new technology while meeting the FRA standards. We did this privately without government funding as the only U.S. owned manufacturer of passenger railcars. We requested and received great cooperation from the FRA to assure that our new U.S. DMU would meet all standards when it was completed. The willingness of the FRA to review our work, interpret the regulations and inspect our new DMU at completion assured us that we were not wasting our funds building a non-compliant railcar.

CREATE U.S. MANUFACTURING JOBS
The development of the DMU in the United States is already creating well-paying manufacturing jobs in Colorado, Oregon, Georgia, Pennsylvania, California, Florida, Illinois and numerous other states. Over 98% of the components of the U.S. DMU are manufactured in the U.S. and they comprise 94% of the value of the railcar.

MAKE RAIL TRANSIT MORE AFFORDABLE TO AMERICANS
By substantially reducing the operating costs of rail transit operations, the U.S. DMU makes rail transit a more affordable, efficient transportation option for America. At a time when every cost associated with passenger transport, from highways to airports to trains, is escalating, here is a technology that can actually reduce the cost of a transport mode.

INCREASE SAFETY BY MEETING ALL FRA AND APTA REGULATIONS AND STANDARDS
The development of the U.S. DMU means that no one has to compromise the regulations established by the Federal Railroad Administration and the standards of the American Public Transportation Association in order to have a cost competitive commuter or

intercity rail system. No one has to accept a reduced standard of strength or safety in order to enjoy the benefits of a DMU.

HOW CAN GOVERNMENT SUPPORT THE ADOPTION OF THIS BENEFICIAL TECHNOLOGY?

The specific benefits of the U.S. DMU technology quantified in the above numbers come from our operating experience over the last two years. I have attached a typical study that we undertake to evaluate any proposed DMU route to determine if the DMU is an economic solution on that route. This study was conducted of two Amtrak routes that appeared well suited to DMU service.

As you can see, the various DMU configurations are all very cost effective on these routes. In fact, the most cost efficient configurations would generate sufficient savings to repay the cost of capital purchase with interest, and still save the operator millions of dollars over the life of the car.

For this reason, we would encourage the Congress and the DOT to consider ways it can foster the use of the DMU technology. This could include budget neutral loan programs for the purchase of DMUs because the rail transport agency savings will be sufficient to repay such loans. This could also include special recognition in the FTA project evaluation process of the long term financial and other benefits of DMU technology.

THE NEED FOR DEMONSTRATION

As noted above, Colorado Railcar manufactured the first modern U.S. DMU in 2002. It was tested at the Technology Test Center in Pueblo, Colorado and then sent on a two-year tour of North America where it operated in nearly every conceivable environment from Alaska to Florida. However, rail transport agencies were very reluctant to adopt this new technology, in spite of the obvious benefits. They wanted to see longer-term proof of its reliability and longer-term demonstration of its cost savings. Ultimately, the demonstration became a reality. But before we discuss the demonstration, let us follow the development of the double deck railcar to the same point in time as the U.S. DMU.

THE DEVELOPMENT OF THE DOUBLE DECK PASSENGER RAILCAR

Over the last 60 years, most of North America's mainline railway has been reconstructed to accommodate increasingly larger and heavier freight cars. The introduction of double stack container service as a major contributor to railroad profits has accelerated the trend of building railways with higher and heavier capacities. There are exceptions to this trend, particularly in the East, and at some passenger stations.

Thus, the passenger railcar industry has evolved larger and larger railcars to more efficiently move passengers over this enlarged system of rails. Evolutions of cars such as the gallery car with two levels as used in Chicago and San Francisco, the multi-level commuter car developed by the Government of Ontario, and the multi-level intercity cars

developed by Pullman and Budd, all followed the opening up of the railway to larger and heavier railcars.

This trend continues today with the development of the double deck railcar. The building of double deck railcars with 25% to 38% more floor space per railcar than the older multi-level railcars has been a natural evolution. These taller (and sometimes longer) railcars bring the same benefits to their owners that made the previous evolutions of the multi-level car attractive. That is, they carry more people per vehicle, at the same or an improved level of comfort, while costing less per seat to purchase, and less per seat to operate and maintain. Furthermore, they help reduce the infrastructure costs by allowing shorter station platforms, shorter parking tracks and requiring fewer maintenance bays.

The development of the double deck passenger car was led by the my company in the late 1980's. The double deck car was substantially larger than the multi-level cars developed over the previous 35 years. It was tall enough that it could have two floors (decks) the full length of the car. Its predecessors only had two floors between the trucks, and one floor over the truck area where the headroom would not permit two floors. Thus the double deck car raised the roof height from the old standard of 15' 10" or 16', to a new height of 17' or 17' 5". In so doing, it increased the available floor space by 20% to 33%.

In the late 1990's, Colorado Railcar expanded the double deck car further by building it higher (to 18' 2"). Then in 2003, the double deck car was lengthened from the standard 85' over couplers to 89'. This added another 5% to available floor space. With this expansion, the double deck car now provided as much as 38% more floor space than the older multi-level designs. Of course, like its predecessor multi-level railcars, it was restricted to use on routes cleared for its increased height. However, by this time, most of the North American mainline had been cleared to this height.

In response to industry demand, in 2005 Colorado Railcar is creating a low floor version of its double deck car by lowering the floor between the trucks from the standard floor level of 51" above top of rail, to 25" above top of rail. While this did not create any additional floor space, it did facilitate disabled boarding and boarding from low-level platforms. And, it certainly did create the most spacious commuter railcar in the world.

THE NEED TO DEMONSTRATE

In spite of the great economies to be achieved by using the double deck railcar, Colorado Railcar found that the rail transport agencies were not willing to adopt this technology. Just like the modern U.S. DMU, these agencies wanted longer-term operating proof of the reliability and cost effectiveness of the new technology. These agencies were writing specifications for new railcars with requirements for up to 10 years of "rail proven service" for new cars.

Furthermore, rail transport agencies were unwilling to consider that experience using the double deck railcar in services other than "commuter rail" was an equivalent service.

By contrast, private businesses like Princess Cruises, Holland America, Royal Caribbean Cruises and Rocky Mountaineer Vacations all rapidly adopted the new double deck railcar. These fast growing successful enterprises could make immediate returns from this innovative technology. To them it seemed a reasonable risk to try the new railcars. In fact, they used each advance in the technology to enhance their competitive position in the cruise or tour marketplace for up-market travelers.

Thus, Colorado Railcar found itself at the same position with the double deck railcar as it was with the U.S. DMU. Rail transit agencies would not order a railcar that did not have a documented history in commuter rail. Without a true demonstration project, it was likely that the double deck railcar and the U.S. DMU would not be adopted by the commuter rail market.

COOPERATIVE FUNDING OF A DEMONSTRATION PROJECT

From about 1999 many discussions about and demonstrations of European DMUs took place in the U.S. Several of these DMUs that were not compliant with FRA regulations were shipped to the U.S. They were run as special short-term demonstrations of the state of the art technology. At the same time, the FRA included in its long-term plan an intention to encourage the development of a DMU that met all U.S. regulations.

In the midst of all this interest in DMUs, Congressman John Mica of Florida, a member of the Railroad Subcommittee, encouraged the efforts of the FRA to promote the development of a compliant DMU. He led the effort to secure funding for a cooperative demonstration under the direction of the FRA. His considerable personal commitment and leadership resulted in the FRA receiving the direction and the funding to undertake a demonstration project. After competitive proposals were evaluated, the FRA made the award to a project funded by Florida DOT and operated by Tri-Rail (SFRTA). Subsequently Tri-Rail (SFRTA) competitively bid the supply of DMUs for the project and Colorado Railcar was the successful bidder.

There were only enough funds available in the FRA\FDOT cooperative program to procure a three car single level trainset. However, all parties wanted to make the program the best possible demonstration and Colorado Railcar decided to contribute the incremental cost of about $2,000,000 in order to demonstrate a three car consist including a single level DMU, a double deck low floor trailer, and a double deck DMU.

The cars for this consist will be delivered to TTCI in Pueblo for testing commencing May 30, 2005. After a month of testing at TTCI they will enter regular weekday service at SFRTA. Under the terms of the demonstration plan they will operate for two years with a minimum of 20 trips per week. Detailed operating results of the demonstration will become a database for the industry and will be used to evaluate the real performance of the new technology.

Colorado Railcar wants to encourage this type of cooperative funding because we believe it is the most cost effective way to get proven new technology into the rail transport agencies where it can reduce the cost of rail transport. Given the high level of federal

funding for many rail transport programs, the deployment of cost effective technology has a great return to the federal government.

Mr. Chairman, thank you again for the opportunity to present this testimony to the committee.

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Summary of DMU Economic Analysis For Amtrak

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Prepared for: **National Railroad Passenger Corporation**
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30th and Market Streets
Philadelphia, PA 19104

1. INTRODUCTION

At the request of Amtrak, Colorado Railcar Manufacturing (CRM) created an analysis comparing the Colorado Railcar Diesel Multiple Unit (DMU) and Amtrak's current locomotives and coaches. The DMU is a self-propelled railcar which offers great efficiencies for many of Amtrak's routes. The analysis for Amtrak focused on the Hiawatha and Heartland Flyer routes, and it compared economics, emissions, noise and design for reliability.

The analysis concludes that:

- The operational cost savings generated by the DMUs pay for their purchase cost twice over.
- On a per-mile basis, the Colorado Railcar DMU has less than one-third the emissions of Amtrak's current locomotive-hauled consists.
- The Colorado Railcar DMU emits 25 percent of the noise of a locomotive-hauled consist.
- The Colorado Railcar DMU is designed for greater in-service reliability than a locomotive-hauled consist.
- Even when we look at the net present value of the operational savings, the DMUs virtually pay for themselves.
    - Depending on the service in which the DMUs are engaged, the net present value of the operational cost savings will pay for 71-146% of the DMU purchase cost, as shown in Table 1 on the next page.

2. ECONOMIC ANALYSIS

Table 1 presents the results of the economic analysis for the Hiawatha service and the Heartland Flyer service.

Table 1. Economic Analysis Results

	Hiawatha Chicago--Milwaukee 440,000 annual service miles 3 consists (1 serves as protect)			Heartland Flyer Oklahoma City--Fort Worth 150,000 annual service miles 1 consist (plus 1 protect locomotive and coach, or 1 DMU)			
Consist	2 single level DMUs 2 single level trailers	2 double deck DMUs	1 locomotive 4 single level trailers 1 cabbage car	2 single level DMUs 1 single level trailer	1 single level DMU 2 single level trailers	1 single level DMU 1 double deck trailer	1 locomotive 3 single level trailers 1 cabbage car
Available Seats in Consist (Approximate)	380	370	368	282	288	302	276
Fuel (Annual Fleet Cost)	$681,000	$601,704	$1,582,000	$175,000	$143,000	$137,268	$497,000
Maintenance (Annual Fleet Cost)	$1,542,000	$1,178,166	$2,091,000	$467,000	$402,000	$333,000	$684,000
Total Annual Fleet Cost	*$2,223,000*	*$1,779,870*	*$3,673,000*	*$642,000*	*$545,000*	*$470,268*	*$1,181,000*
Annual Savings	$1,450,000	$1,893,130		$539,000	$636,000	$710,732	
30-Year Savings (Inflated at 3% annually)	**$68,875,000**	**$89,923,675**		**$25,602,500**	**$30,210,000**	**$33,759,770**	
Purchase Price	**$39,330,000**	**$25,200,000**		**$13,733,000**	**$13,110,000**	**$10,400,000**	
Savings as a Percent of Purchase Price	**175%**	**357%**		**186%**	**230%**	**325%**	
Present Value of 30-Year Savings (Discounted at 3.1%)	**$28,057,500**	**$36,632,066**		**$10,429,650**	**$12,306,600**	**$13,752,664**	
Present Value of Savings as a Percent of Purchase Price	**71%**	**145%**		**76%**	**94%**	**132%**	

3. EMISSIONS ANALYSIS

The Colorado Railcar DMU emits significantly less pollution than a comparable locomotive-hauled consist. Generally speaking, the DMU has less than one third the pollution of a locomotive-hauled consist. The economic value of this benefit was not considered in the economic analysis.

4. NOISE ANALYSIS

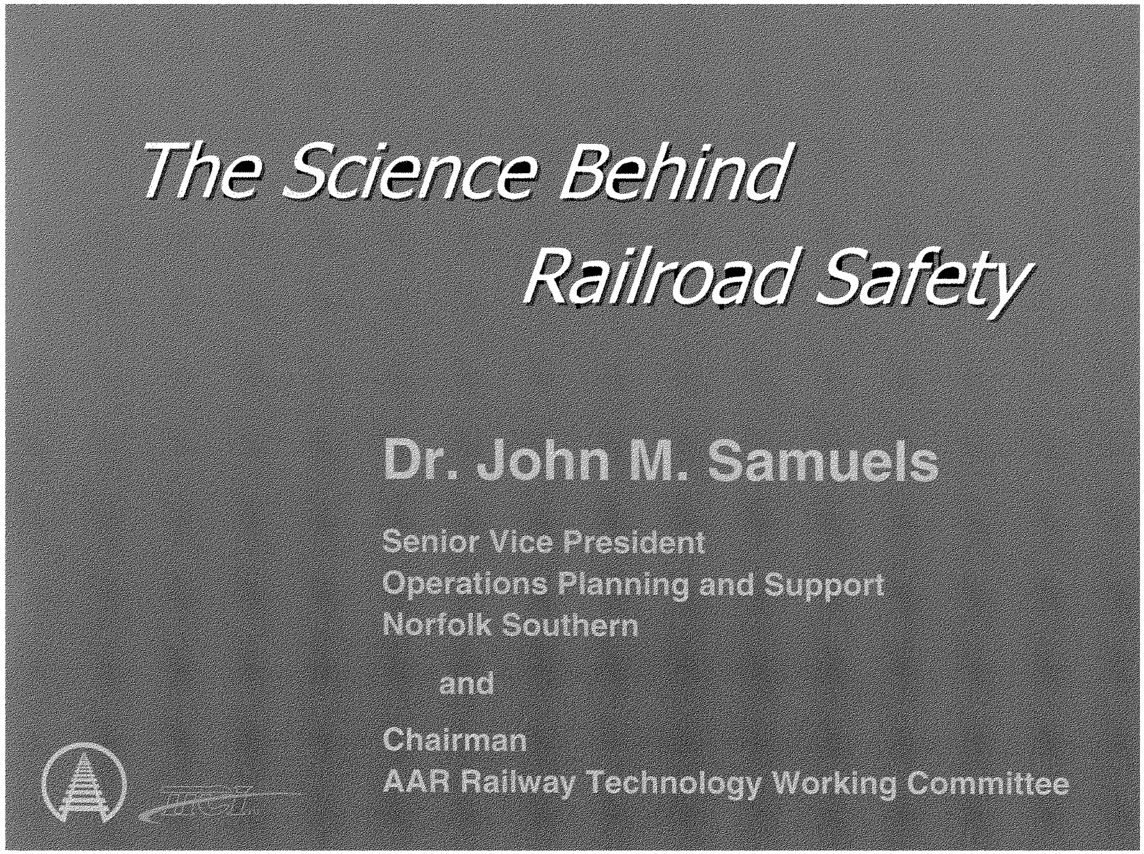
The Colorado Railcar DMU emits 25 percent of the noise of a locomotive-hauled consist. Passby tests have shown that the DMU is 12 decibels quieter than a locomotive, which is equivalent to a 75 percent decrease in the perceived sound level. Further details are available from CRM in the document TD-02.003 Revision A, "CRM DMU Noise Data." The economic value of this benefit was not considered in the economic analysis.

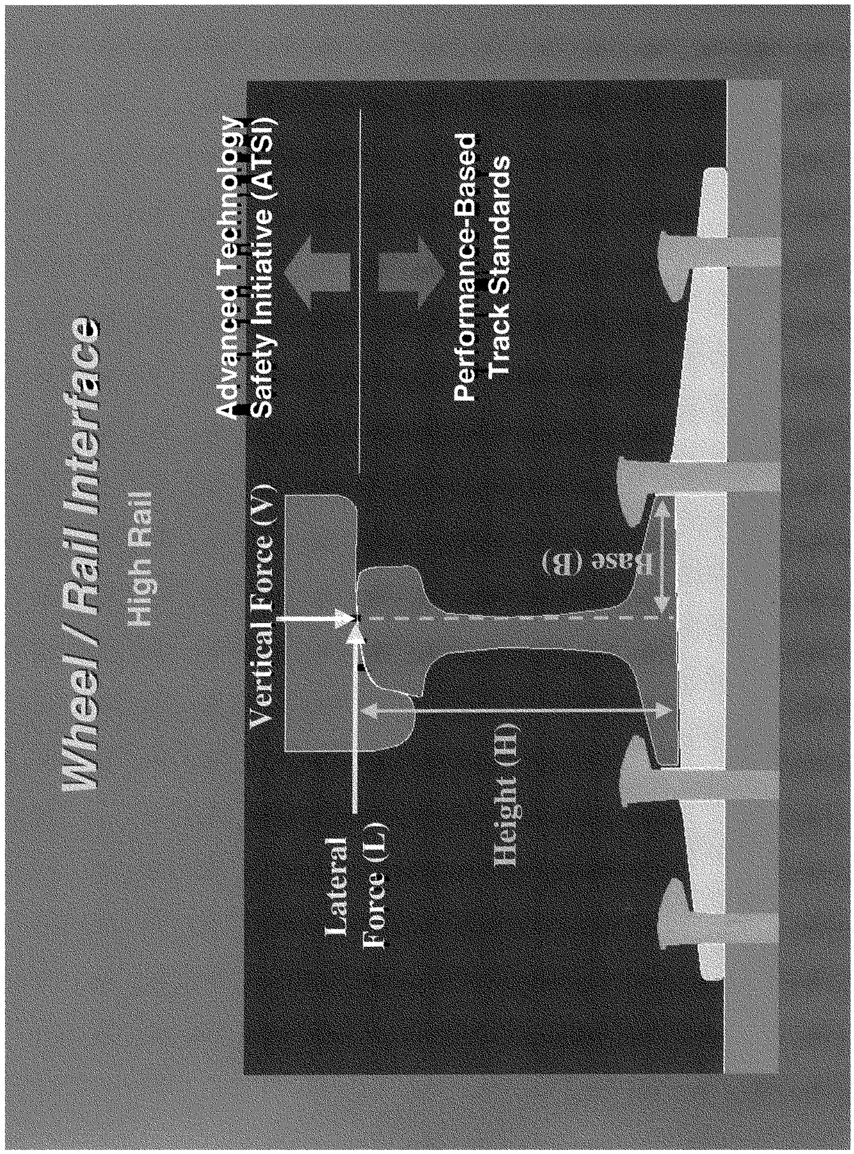
5. DESIGN FOR RELIABILITY

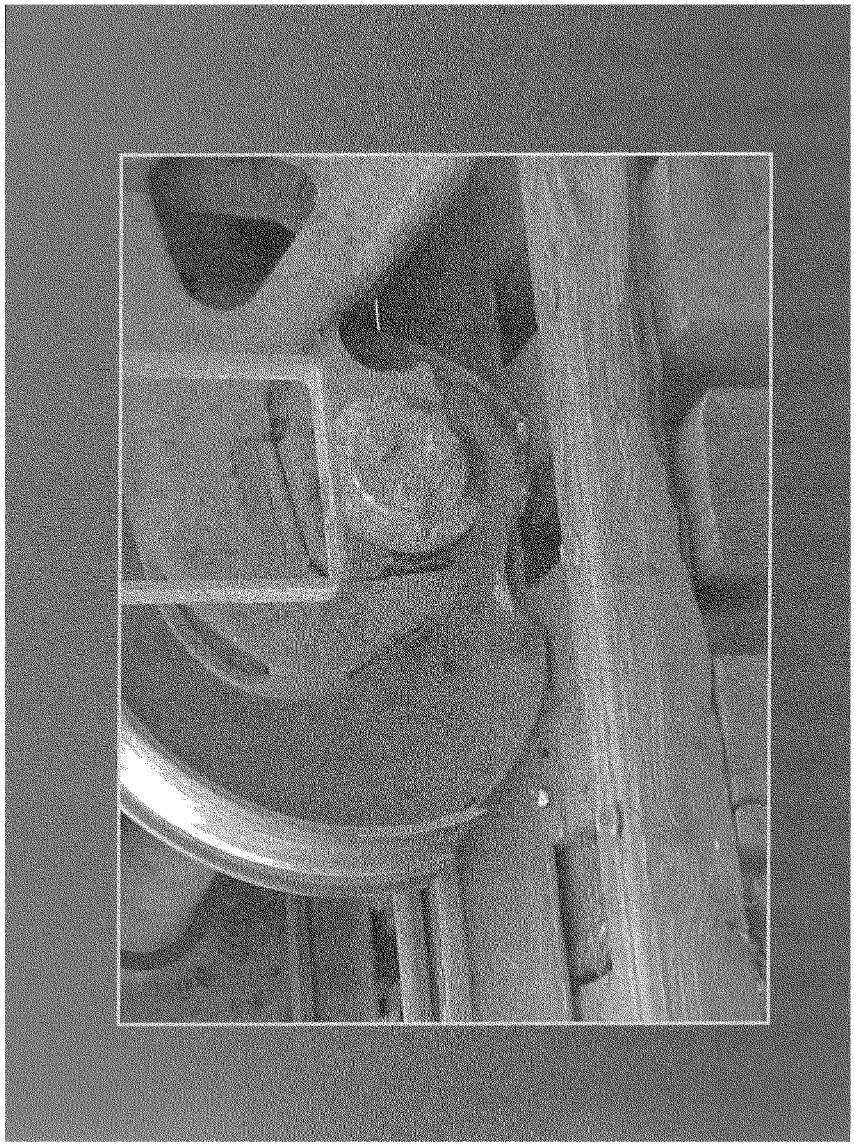
DMUs are designed to deliver a more reliable service than locomotive-hauled consists. The DMU is designed for reliability, with expertly integrated components that have high, proven in-service reliability. DMUs also have redundant propulsion packages (which include the engine, transmission, charge air cooler, and cooling pump). This allows the DMU to "limp home" with only a few minutes delay in the unusual event that a propulsion package is disabled. A disabled locomotive does not have this ability and will instead result in stranded passengers and will delay all other traffic until the locomotive is rescued. The economic value of this benefit was not considered in the economic analysis.

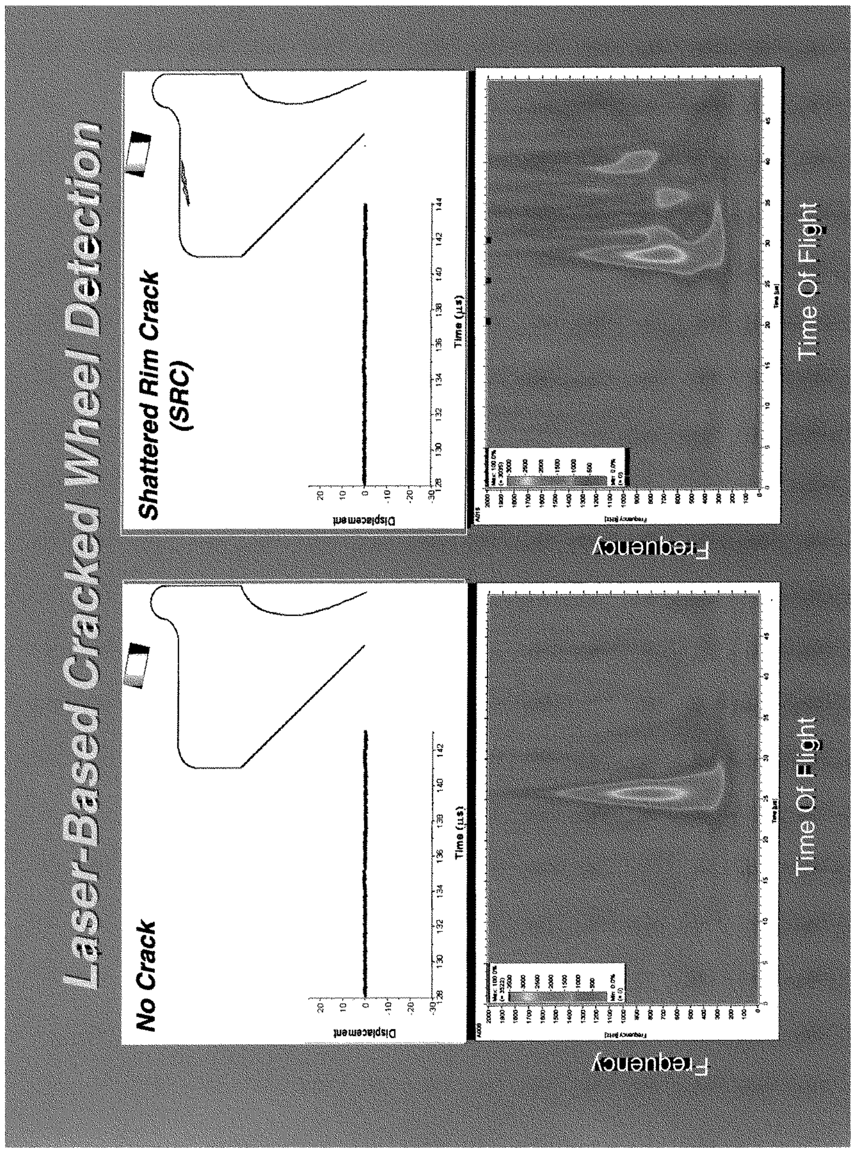
6. FOR MORE INFORMATION

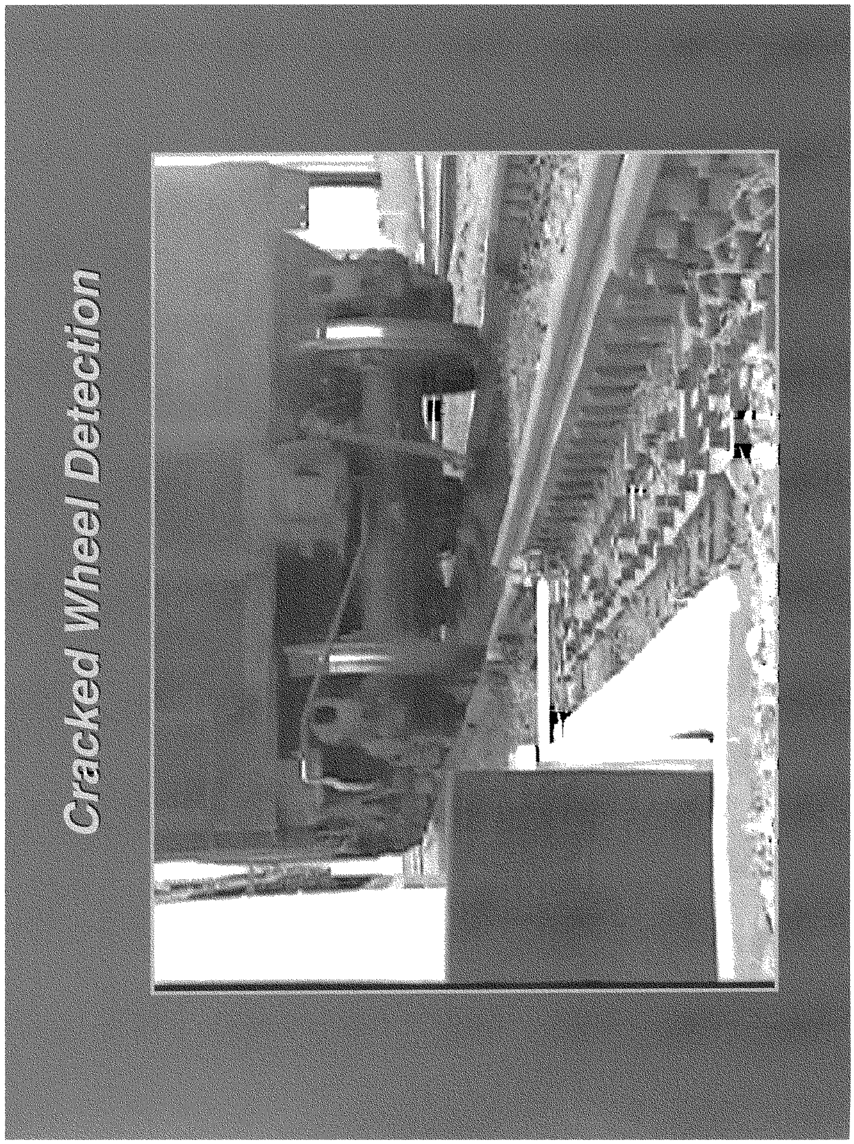
Contact Christina Messa, Director of Economics and Environment for Colorado Railcar, at (303) 670-1585 ext. 303 or at christina.messa@coloradorailcar.com.

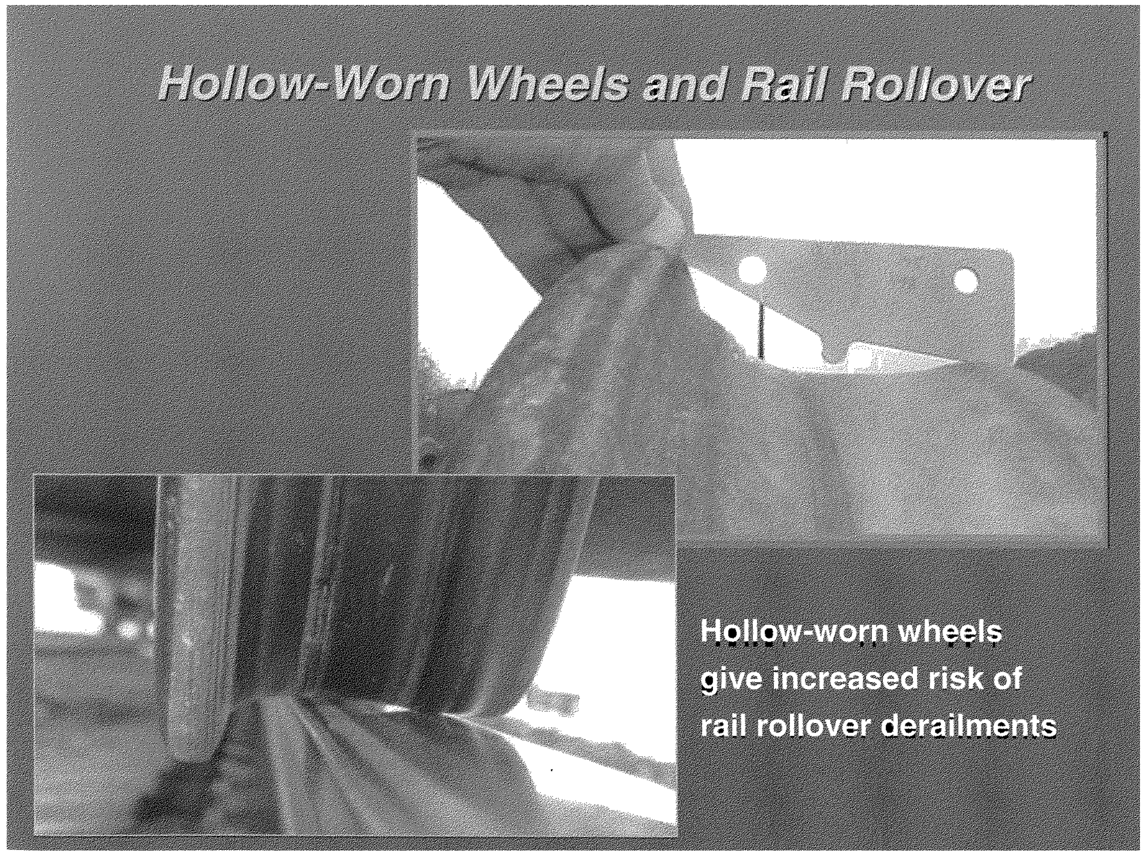

The Science Behind
Railroad Safety
Dr. John M. Samuels
Senior Vice President
Operations Planning and Support
Norfolk Southern
and
Chairman
AAR Railway Technology Working Committee

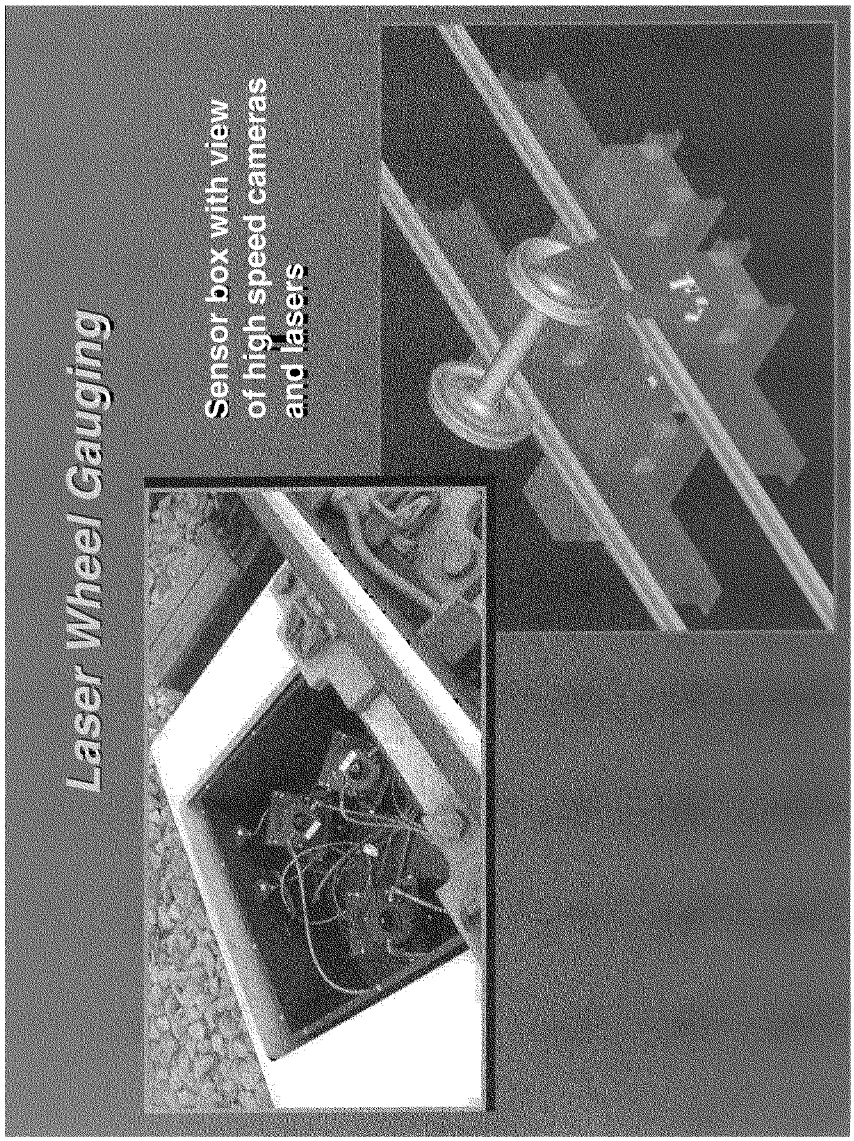

Wheel / Rail Interface
High Rail
Advanced Technology
Safety Initiative (ATSI)
Performance-Based
Track Standards
Vertical Force (V)
Lateral
Force (L)
Height (H)
Base (B)

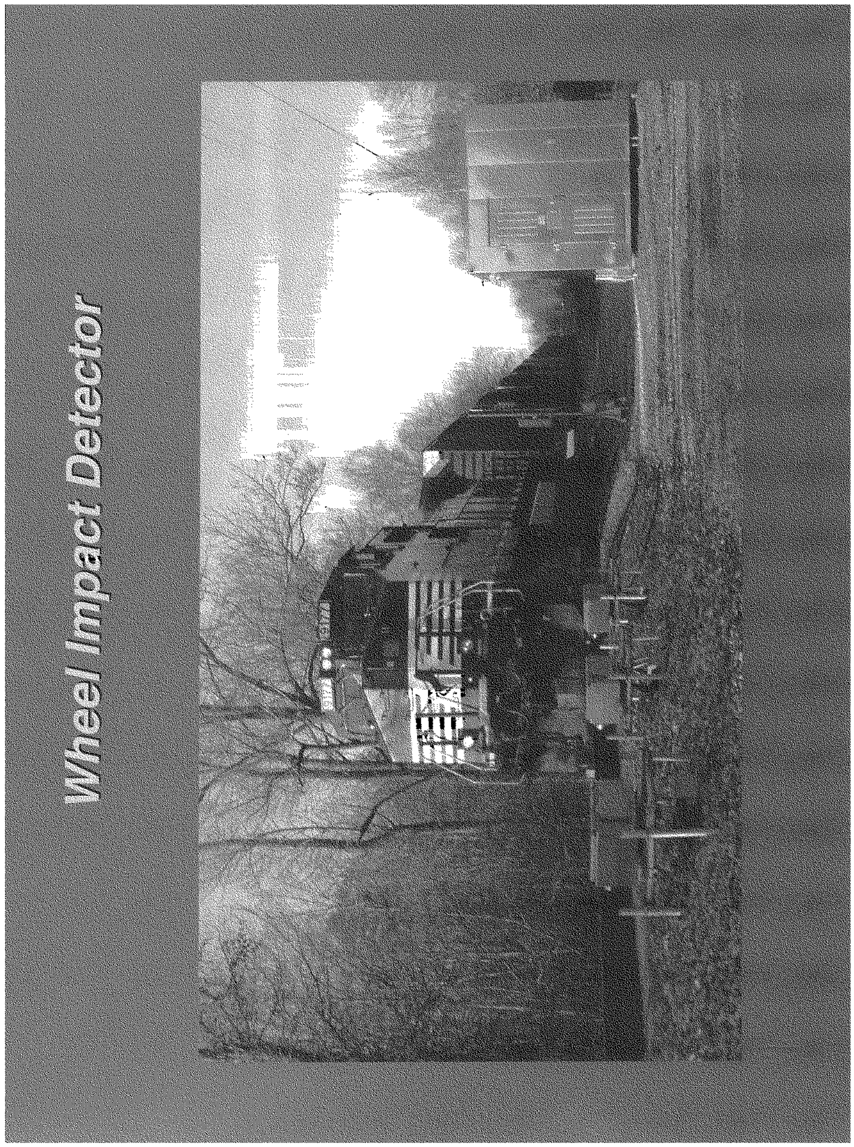


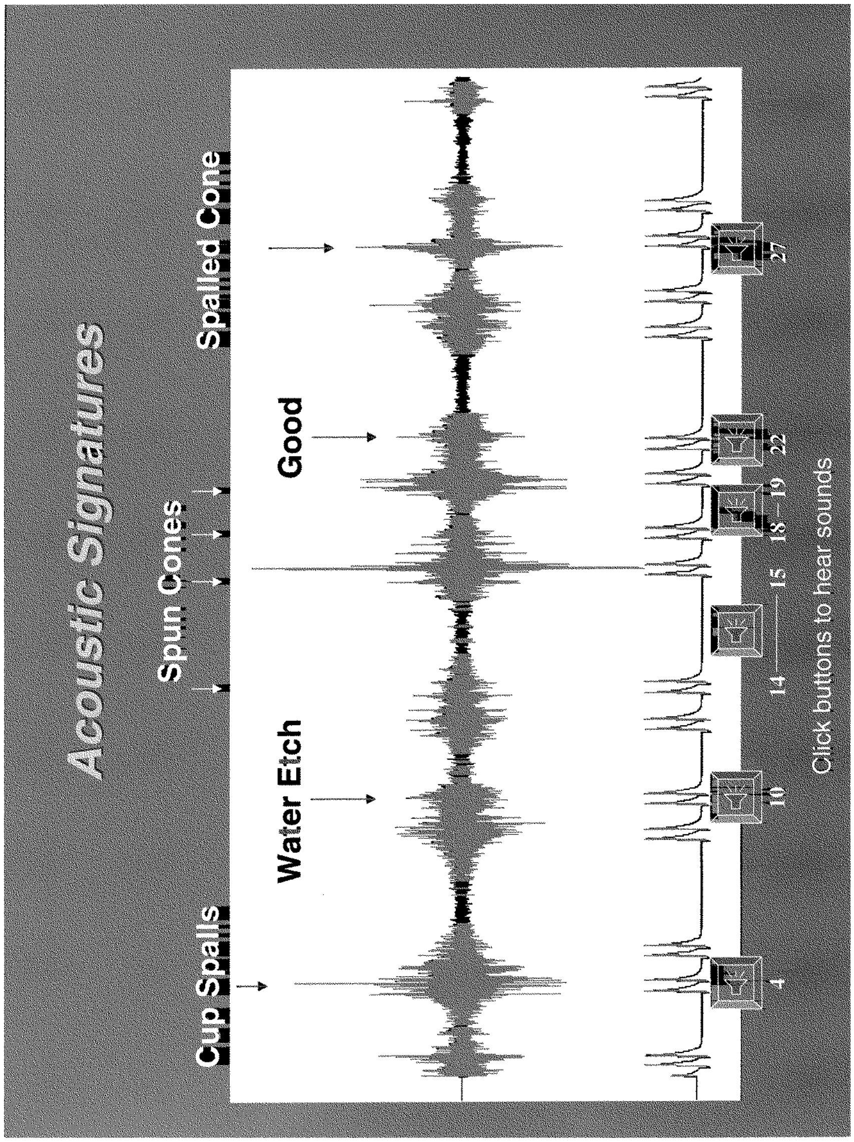

Laser-Based Cracked Wheel Detection
No Crack
Shattered Rim Crack
(SRC)
Displacement
Time (μs)
Frequency
Time Of Flight
Frequency
Time Of Flight

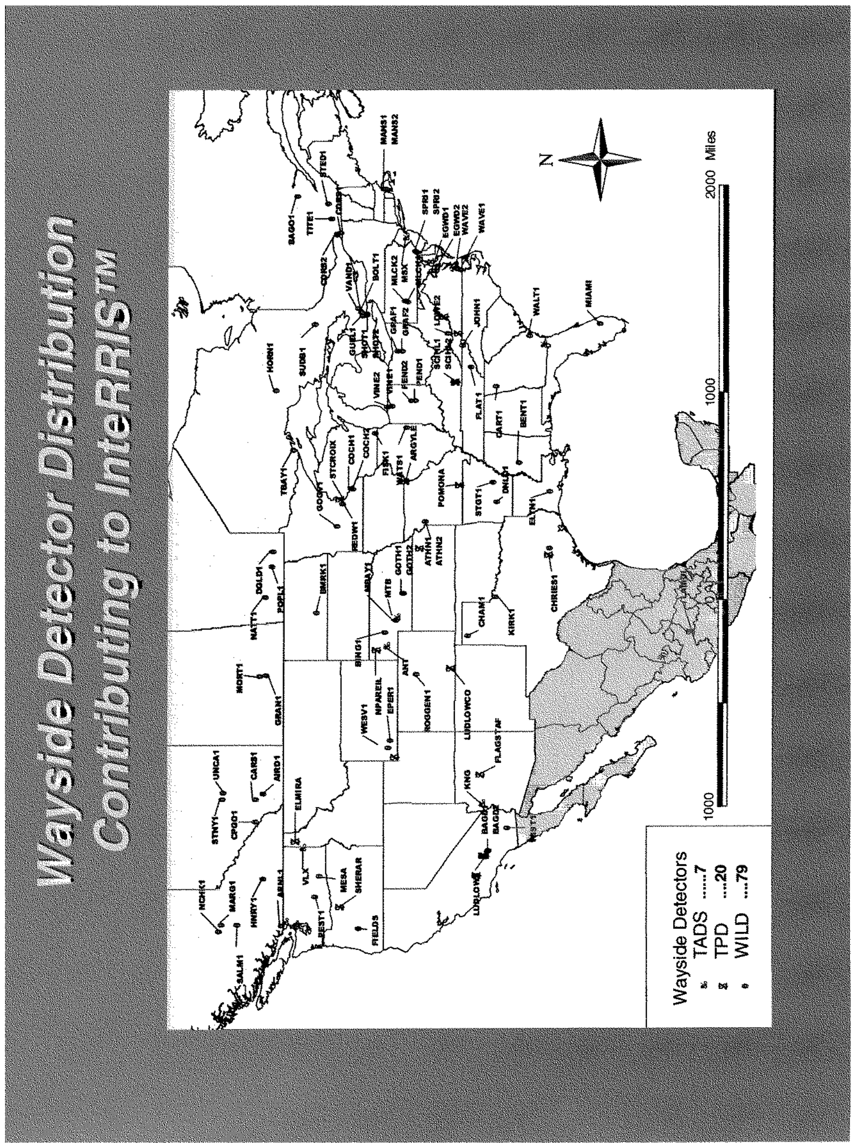

Cracked Wheel Detection

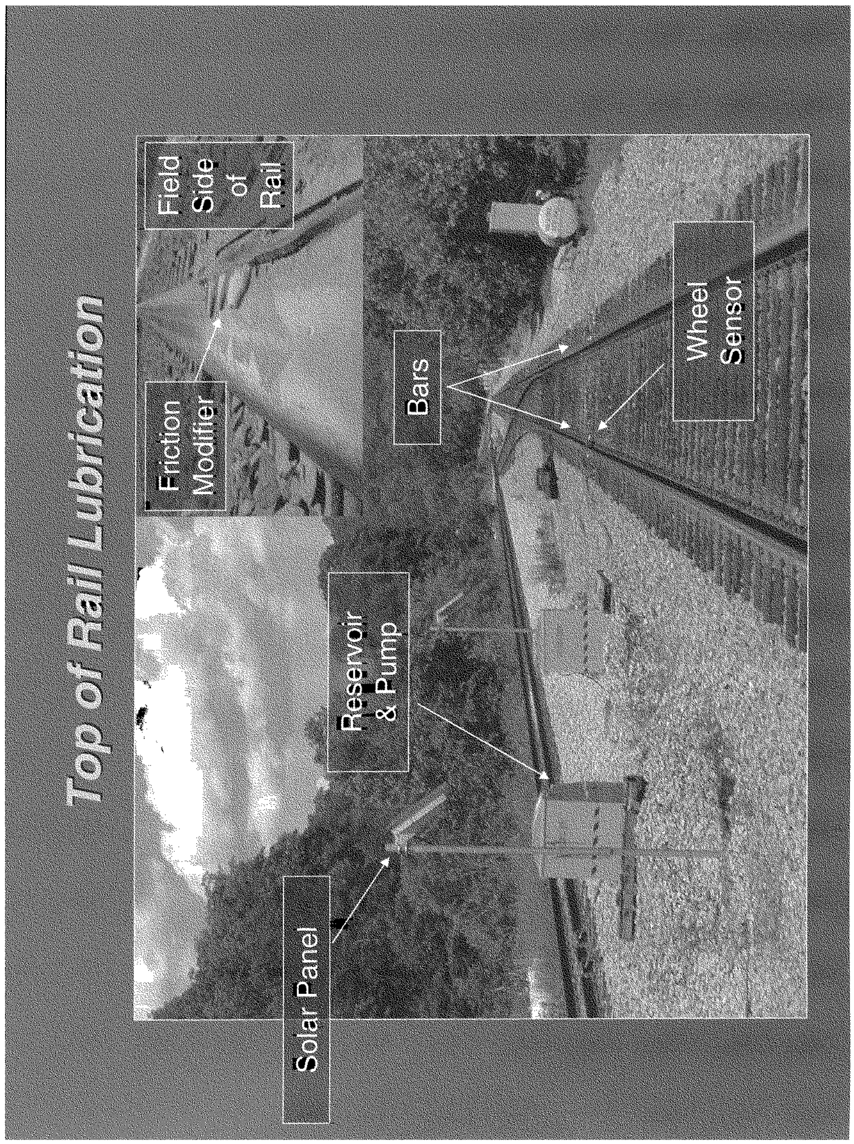

Hollow-Worn Wheels and Rail Rollover
Hollow-worn wheels
give increased risk of
rail rollover derailments

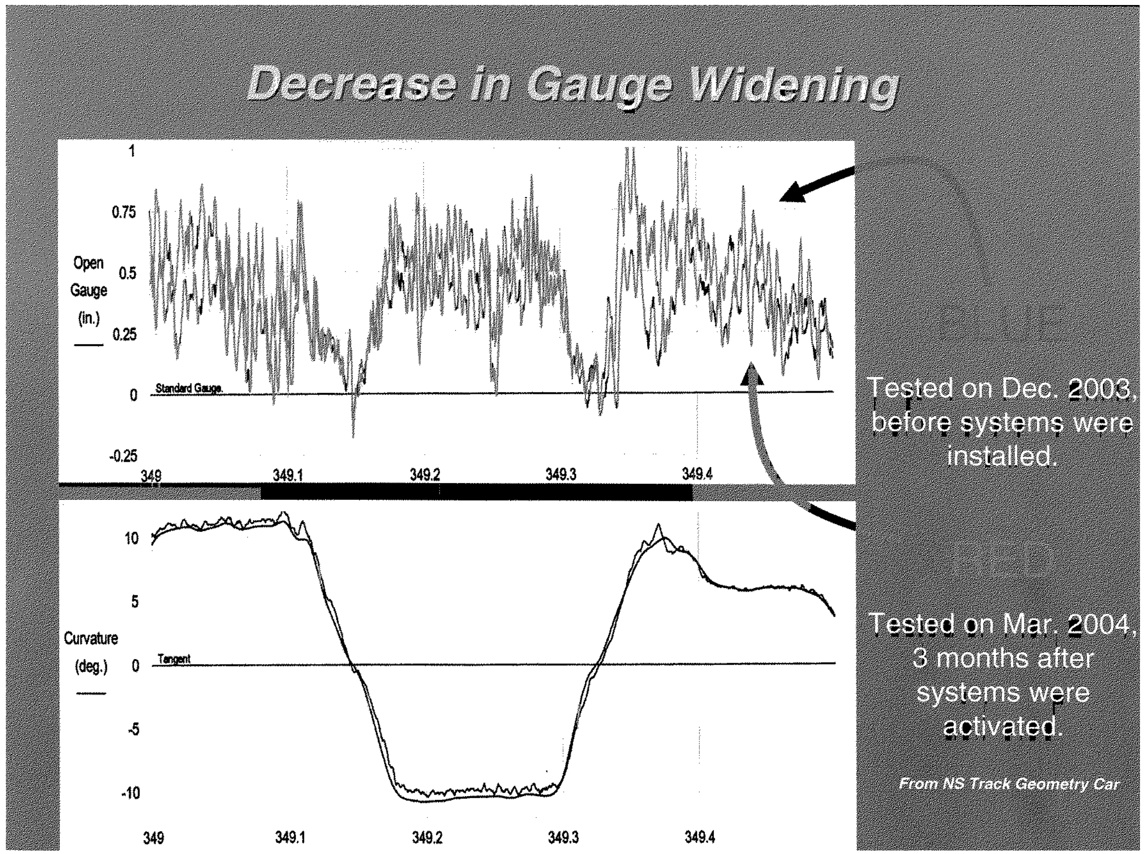

Laser Wheel Gauging
Sensor box with view of high speed cameras and lasers


Wheel Impact Detector


Acoustic Signatures
Cup Spalls
Water Etch
Spun Cones
Good
Spalled Cone
4
10
14
15
18
19
22
27
Click buttons to hear sounds


Wayside Detector Distribution
Contributing to InteRRIS™
Wayside Detectors
TADS 7
TPD 20
WILD 79
1000
1000
2000 Miles
N


Top of Rail Lubrication
Solar Panel
Reservoir & Pump
Friction Modifier
Field Side of Rail
Bars
Wheel Sensor


Decrease in Gauge Widening
Open Gauge (in.)
1
0.75
0.5
0.25
0
-0.25
Standard Gauge
349
349.1
349.2
349.3
349.4
Curvature (deg.)
10
5
0
-5
-10
Tangent
349
349.1
349.2
349.3
349.4
BLUE
Tested on Dec. 2003, before systems were installed.
RED
Tested on Mar. 2004, 3 months after systems were activated.
From NS Track Geometry Car


Rail with Internal Crack

Statement of Jo Strang,
Deputy Associate Administrator for Railroad Development,
Federal Railroad Administration
before
the Subcommittee on Railroads,
Committee on Transportation and Infrastructure,
U.S. House of Representatives
April 28, 2005

Mr. Chairman and members of the Subcommittee, I very much appreciate the opportunity to appear before you today, on behalf of Secretary Mineta and Acting Administrator Jamison, to discuss new rail safety technologies. Safety is our top priority, and the promise that technology holds to improve safety is compelling. Recent statistics show that the industry as a whole is getting safer, but the spate of recent, highly publicized accidents shows that there is still room for improvement, and we must accelerate the rate of progress. We are addressing these issues through better use of data, focusing oversight and inspection resources, and accelerating research in key areas.

In general, the safety trends on the Nation's railroads are favorable. The preliminary data for calendar year 2004 show that since 2003, total accidents/incidents are down 3.92 percent, and total employee casualties are down 8.75 percent.

However, not all trends are positive. Improvements in the rate of train accidents have slowed, and significant accidents continue to occur. Human factors and track continue to be the leading causes of accidents.

FRA is committed to improving this record, and we are focusing on ways to prevent train accidents and–where they are not prevented–to mitigate their consequences. I will focus my testimony on innovative new technologies that hold great promise to improve railroad safety.

Track Inspection

Track defects accounted for 34 percent of derailments over the last five years. To address this accident cause, FRA has an active research program for developing and deploying enhanced track inspection systems as a

preventive approach to reducing track accidents by detecting defects before they can cause an accident.

I wish to briefly describe some of the key systems for track inspection that FRA is currently developing:

1. **Automated joint bar inspection system:** While derailments due to broken joint bars are infrequent, on some occasions they have severe consequences. Current joint bar inspection practices rely primarily on visual inspection and, in a few cases, hand mapping with ultrasonic probes. These methods are not only time intensive; they are prone to human errors of interpretation and fail to detect all cracks. To provide an alternative, FRA is developing a high-speed photo inspection system that will identify the presence of a joint bar in continuous welded rail (CWR), take a high-resolution, high-quality picture of the gage and field sides of the joint bar, and use pattern-recognition software to automatically detect a crack and create a report for use by the railroad. Initial tests of this technology are promising. The tests show that a prototype system mounted to a hi-rail vehicle and operated at speeds of 30 miles per hour was able to detect all cracked bars identified by visual inspection, as well as additional cracks undetected by the human eye.

2. **Track geometry measurement systems:** Track gage, which is the distance between the two rails, must be maintained to certain tolerances for safe rail operation. Wide track gage is the single leading cause of derailments. FRA actively monitors track geometry through the deployment of its full-scale measurement cars, the T-2000 and the T-16, on numerous rail routes supporting passenger and hazardous materials transportation. Another specialized inspection car, the FRA T-18, has been deployed for inspections since January of this year. It applies gage spreading loads to measure the dynamic gage widening (which is the short-term widening caused by the passage of heavy equipment), therefore allowing identification of spots with weak tie and rail fastener conditions, which may not be detectable by visual inspection. Technology enhancements are continuously being added to these measurement cars to improve their inspection effectiveness, and to provide real-time analyses for better assessment of track conditions. One example is the integration of Global Positioning System (GPS) navigation data with all detected

defects to allow for accurate mapping of their location to within a few feet. This capability facilitates further field inspection and removal of the defect. Another is the deployment of optical and laser non-contact sensors for more accurate mapping of track geometry at much greater operating speeds. Our T-16 car can be towed at speeds of up to 140 mph and still manage to measure track alignment, gage, cross-level, and profile once per foot. Our T-18 represents an innovation in track inspection through the use of an independent axle for applying the gage spreading loads, which permits safer testing at faster track speeds. Another promising technology currently under development at FRA is the development of intelligent systems for real-time assessment of the measured geometry based on a predicted response from an array of rail cars. This capability will allow better identification of hazardous locations where a combination of near-defects can create a potential for derailment. FRA is also developing an autonomous measurement system for mounting under a conventional rail car that can be more easily transported over the larger rail network. This system has the capability of detecting serious track geometry defects while simultaneously sending their details to a remote location for a variety of purposes, including later repair. We expect to test this system by September of this year.

3. FRA has developed a new and more intuitive Track Quality Index (TQI) that can be calculated from the measured track geometry and displayed onboard the T-16 inspection car. Basically, TQI visually depicts, in real time, the relative overall condition of track on a one-tenth of a mile basis in relation to the national average quality, thus allowing the identification of track segments of poor quality.

4. Internal rail defects due to fatigue remain a serious problem because of the associated risk of sudden rail failure that typically occurs under a moving train. Improvements in rail construction and maintenance practices through the use of more wear-resistant rail steel and the wider use of lubrication have increased the design life of the rail. However, they have also elevated rail fatigue as the more dominant form of failure. Recent trends in increasing freight axle loads, which are currently near 40 tons, have also exacerbated this problem. Internal defects can only be identified by specialized ultrasonic or induction measurement cars that still cannot be operated at more than 10 miles per hour on the average. Also, with current inspection

technology some defects may be misdiagnosed as to their true size or go undetected altogether. Defects in the web or base sections of the rail are also extremely difficult to detect. Both FRA and the Association of American Railroads (AAR) are pursuing inspection technology improvements in this area, which can increase the speed and reliability of automated track inspection cars and expand the range of defects that can be detected. The techniques being pursued include using laser-induced ultrasound and the use of guided waves. Prototype sensors are currently under development with initial tests scheduled for the latter part of this year.

Ground Penetrating Radar

Another promising technology that FRA has identified for the diagnosis of safety-related track subsurface problems is Ground Penetrating Radar (GPR). The study of this technology will likely result in the development of on-board sensor systems that can assess track subsurface conditions in a rapid, accurate, consistent, and reliable manner in real-time at track speed. Currently, there is no non-destructive inspection technique available. The goal of the project is therefore to develop an automated GPR to assess the condition of the railway track substructure (ballast, subballast and subgrade) and produce quantitative indices of track substructure condition. The GPR-derived indices will enable better maintenance and rehabilitation decision-making resulting in an improved track substructure performance. We expect that this will result in increased safety and reduced train service interruptions through more effective use of limited maintenance and capital resources. Ultimately, the goal of the project is to develop GPR as an important part of a comprehensive substructure maintenance management program that will lead to informed decision making for maintenance and capital improvements. The system is intended for use on a hi-rail vehicle or a track geometry car for system-wide applicability. The current phase of the project is to develop the hardware/software specifications for a prototype system to be installed on the FRA's Research Platform (T-18) for field-testing in Spring 2006. The prototype GPR system being developed will use radio frequency techniques that protect other transportation systems such as GPS from interference.

Positive Train Control (PTC)

PTC is an advanced train control technology that can prevent train collisions with automatic brake applications. It also provides capabilities such as automatic compliance with speed restrictions and enhanced protection of maintenance-of-way workers.

FRA's final rule enabling PTC became effective on March 7, 2005. The rule is a performance standard for PTC systems that railroads may choose to install, but does not require PTC systems to be installed. Rather, FRA is promoting the implementation of PTC by sponsoring development of PTC technologies though partnerships with States and railroads; and by helping to provide the Nationwide Differential Global Positioning System, a satellite-based navigation aid (described below) that is essential for communications-based PTC projects.

Today, Amtrak and other Northeast Corridor railroads have implemented a form of PTC that supports train speeds up to 150 miles per hour. This system works well; however, it is expensive and does not offer some operational efficiencies that may be available with newer PTC systems. Therefore, this system does not appear to be appropriate for use outside the Northeast Corridor.

FRA's Office of Railroad Development is currently working on PTC projects in Michigan, Illinois, and Wisconsin. The next challenge is to continue to drive down implementation costs.

In addition, several freight railroads are exploring less complex "overlay" systems with a goal of increasing safety and improving operating efficiencies. The farthest along in testing is the Electronic Train Management System (ETMS) on the Burlington Northern Santa Fe. CSX Transportation is working towards the Communications Based Train Management System and the Alaska Railroad is also working towards implementing a PTC system on its entire territory.

A significant challenge for FRA and the railroads in developing all such systems is to ensure that they are interoperable (that is, locomotives from railroad "A" having one kind of PTC system can operate on railroad "B" which has a different PTC system).

Nationwide Differential Global Positioning System (NDGPS)

The Subcommittee has asked that we also address NDGPS, which is PTC's fundamental radio navigation system. NDGPS is a network of reference stations that monitors GPS and transmits signals to an unlimited number of users. These signals are used by the NDGPS receiver to improve the accuracy and integrity of GPS. When complete, there will be approximately 130 NDGPS transmitter sites in the United States; this is the basic dual-coverage network for the continental 48 States. The NDGPS system includes preexisting Coast Guard Differential GPS sites, converts 46 transmitter sites of a de-commissioned U.S. Air Force system into NDGPS sites, and builds new sites where needed. Currently, 92 percent of the 48 contiguous States are covered with single NDGPS, and 60 percent is covered with dual coverage. When complete, there will be dual coverage throughout the United States to ensure the signals are always available.

Currently, GPS technology has an assured accuracy of 36 meters. Since parallel railroad tracks are only 4 meters apart, GPS accuracy does not meet our needs. Basic NDGPS improves the accuracy to 1 to 2 meters. Similarly, the time it takes the GPS system to recognize that a satellite is out of tolerance and notify the users can be as much as 2-4 hours. This is referred to as "time to alarm integrity." Basic NDGPS improves the time to alarm integrity to 6 seconds. So, if a GPS satellite malfunctions, the NDGPS system eliminates the bad satellite from the position solution within 6 seconds, preventing any disruption to railroad operations. High Accuracy NDGPS, for which the Administration is not seeking funding in the Budget, would improve position accuracy to about 10 centimeters, and time to alarm integrity to 1 to 2 seconds. High Accuracy NDGPS would enable Automated Rail Surveying and Rail Defect Detection systems to operate at rail traffic speeds while collecting valuable data that will improve the safety and efficiency of the Nation's rail system.

NDGPS is an enabling technology that is used in a wide variety of non-railroad applications, including precision farming, maritime navigation, surveying, map-making, plate tectonic monitoring, and weather forecasting. Because it is an enabling technology, many Federal and State agencies and universities have been willing to contribute funding, land, and engineering resources to the program to ensure its success. The Federal agencies that have significantly contributed to the development of NDGPS include: the Departments of Transportation, the Air Force, the Army, Commerce,

Interior, and Energy; the Tennessee Valley Authority; and the Voice of America. The States that have partnered with FRA in the deployment of NDGPS include California, Idaho, Minnesota, Montana, North Carolina, North Dakota, Tennessee, Utah, Virginia, West Virginia, and Wyoming. The NDGPS project is an excellent example of interagency cooperation and outstanding partnerships with States.

Passenger Equipment Safety

In contrast to the European rail system, traffic on the U.S. rail system is dominated by private freight traffic and produces a more rugged operating environment. Passenger trains commonly share the same tracks with freight trains weighing 15,000 tons or more, and PTC is a rarity. Highway-rail crossings are common in the United States; there are more than 250,000. Commercial trucks in this country are much heavier than typical European trucks, so the risk of a highway-rail crossing collision with a subsequent derailment is greater in the U. S. Therefore, we have sought to provide railroad passenger equipment safety standards that take into account our more rugged operating environment.

FRA issued comprehensive Passenger Equipment Safety Standards in 1999. The rule's crashworthiness standards ensure that a passenger train has features providing a superior level of occupant protection for passengers and crew in the event of a collision or derailment. The standards require features designed to overcome most of the known reasons for deaths and injuries in previous wrecks, such as high static end strength, corner posts, collision posts, anti-climbing mechanisms, roll-over strength, side strength, truck-to-car-body attachment, glazing, locomotive fuel tanks, and emergency exits and lighting, among others. Further rulemaking is ongoing to cover matters left unfinished.

FRA continues to address the crashworthiness of passenger equipment as well as enhanced passenger and crew protection through our full-scale crash test program. Our main partners in this important research are the American Public Transportation Association (APTA) and Amtrak.

Computer models have been developed to simulate a variety of passenger rail car crash scenarios. These models, combined with the results of crash tests and field investigations of passenger train accidents, are being used to develop strategies for increasing occupant protection. The role of these tests

is to measure and compare the crashworthiness performance of existing passenger equipment and modified designs.

FRA is now testing two components of structural crashworthiness for passenger rail equipment: a crush-zone for coaches, or cars that are coupled together and a crush-zone for cab cars, or cars that would need protection if striking an object. So far, we have completed both designs and tested the crush-zone design for the coaches.

We conducted a single-car test of a Crash Energy Management (CEM) coach car on December 3, 2003. A two-car test of CEM coach cars was conducted on February 24, 2004. We have also just completed the cab-car crush zone design. An existing cab car will soon be retrofitted with crush zones. This cab car, along with coach cars similarly retrofitted, will be used in a train-to-train full-scale impact test.

The test results from the single-car and two-car impact tests show that the CEM design has superior crashworthiness performance over conventional equipment. In the single car test of conventional equipment, the car crushed by approximately six feet, intruding into the occupied area, and lifted by about nine inches, raising the wheels of the lead truck off the rails. Under the same single-car test conditions, the CEM car crushed about three feet, preserving the occupied area, and its wheels remained on the rails. In the two-car test of conventional equipment, the conventional car again crushed by approximately six feet, and lifted about nine inches as it crushed; in addition, the coupled cars sawtooth-buckled, and the trucks immediately adjacent to the coupled connection derailed. In the two-car test of CEM equipment, the cars preserved the occupant areas and remained in-line, with all of the wheels on the rails.

In the train-to-train test of conventional equipment, the colliding cab car crushed by approximately 22 feet and overrode the locomotive. The space for the operator's seat and for approximately ten rows of passenger seats was lost. Computer simulations of the train-to-train test of CEM equipment indicate that the cab car will crush by approximately three feet, and that override will be prevented. Structural crush will be pushed back to all of the coach car crush zones, and all of the crew and passenger space will be preserved. The train-to-train test of CEM equipment, which is planned for February 2006, expected to confirm these predictions.

We are currently discussing applying the results of the CEM research and development with the industry in the Railroad Safety Advisory Committee's Passenger Safety Working Group and in the APTA Passenger Rail Equipment Safety Standards Committee. We are also working with Metrolink, a commuter railroad in southern California, to add CEM to their next car purchase, as well as the Federal Transit Administration to determine ways to create incentives for early adoption of the results of this research.

Advances in Locomotive Crashworthiness

FRA is also actively addressing the crashworthiness of freight locomotives. Participants in this effort include the passenger and freight railroads, rail labor organizations, and locomotive builders. This program has:

1. Developed computer models and testing tools to evaluate locomotive crashworthiness;
2. Evaluated current design locomotives for crashworthiness under common accident scenarios;
3. Considered alternative design improvements with modeling, static testing and full-scale crash testing;
4. Verified and validated models through full-scale crash testing; and
5. Developed means to mitigate injuries to crew.

A total of seven tests have been conducted to date, all testing specific types of accidents that could result in fatalities in regular operations. All tests were simulated prior to the actual crash test using computer modeling. The model predictions closely matched the actual test results. At least in part as a result of modeling and testing, the AAR has adopted a revised standard, S-580 (December 2004), which incorporates improvements in locomotive design.

On-Board Condition Monitoring System

Another way that FRA is striving to improve railroad safety is a project to develop and demonstrate a real-time, on-board condition monitoring system (OBCMS) for freight trains. The objective of the system is to improve railroad safety and efficiency through continuous monitoring of mechanical components in order to detect defects before they cause derailments. The system monitors the condition of the bearings, wheels, trucks, and brakes. The monitoring system has been installed on five hopper cars owned by

Southern Company Services. The OBCMS is currently being operated in revenue service on a coal train operating on a Norfolk Southern route in Alabama between a coalmine northwest of Birmingham and Gaston Steam Plant in Wilsonville, Alabama. The Southern Company test cars are also equipped with the Timken Guardian Bearing Monitoring System, which monitors the car speed as well as the vibration and temperature of the bearings. The system features some of the latest technology in communications and railroad bearings.

Work is currently in progress to extend the capabilities of the OBCMS to include operation of mechanical devices from the locomotive. The devices being integrated (referred to collectively as *advanced components*) include parking brakes, advanced couplers, angle cocks, cut-out, levers, and a cushion unit lockout mechanism to control slack in the train. FRA has been sponsoring the development of the advanced components through the Small Business Innovation Research (SBIR) program. These components have reached the stage of development where they can be integrated with the OBCMS. These devices will improve railroad safety and operational efficiency since they permit various mechanical functions to be controlled remotely from the locomotive instead of manually. The OBCMS with advanced components will be installed on five freight cars for demonstration.

Hazardous Materials and Tank Car Safety

FRA is also working hard on projects intended to both reduce the likelihood that a train accident will result in a hazardous material release and to ensure that, if a release occurs, local emergency responders will be fully prepared to minimize the damage and loss of life that might occur. The Graniteville, South Carolina, accident, which tragically resulted in at least nine deaths as the result of the release of chlorine, demonstrates the potential for serious consequences from train accidents involving tank cars carrying hazardous material.

An important component of minimizing the impact of a hazardous material release is the emergency response. Emergency responders are trained and generally well prepared on how to locate shipping papers on trains and read placards and other hazard communication markings. However, it may be possible for railroads to immediately distribute the necessary information electronically to all affected emergency responders upon notification of a

train accident. The emergency responders identified that information needs to be phase specific. While information immediately available in the first 15 to 20 minutes of a response is generally sufficient, the key element is verification to ensure seamless transition into later phases. Initial discussions with the railroads and emergency responders show both interest and willingness to pursue an improved flow of information. All necessary information is currently available; the missing piece is communications infrastructure to support response improvement. FRA will continue to progress this effort as rapidly as possible.

FRA is focusing on research arising from the Minot, North Dakota, accident in 2002, which resulted in one death and 11 injuries due to the release of anhydrous ammonia. We are working with the Volpe National Transportation Systems Center and the AAR Tank Car Committee. Current research involves a three-phase approach to assess the consequences of tank cars involved in derailments. The first phase is development of a physics-based model to analyze the kinematics of rail cars involved in a derailment. The second phase is development of dynamic structural analysis models. The third phase is an assessment of the damage created by puncture and entails the application of fracture mechanics testing and analysis methods. The modeling work is being conducted now. Work on tank car structural integrity will also be applicable to the Macdona, Texas, accident in 2004 (which resulted in three deaths due to the release of chlorine) and to the Graniteville accident. This research will help improve our understanding of how tank cars fail, and that knowledge will help us improve tank car design in the future.

In addition, an explosive-resistant coating is being used to enhance the armor protection of military vehicles in Iraq. FRA intends to evaluate it for potential use on tank cars to prevent puncture. The material also has a self-sealing property that could be useful to seal a hole in a tank car and mitigate the severity of incidents. The material is a spray-on polyurea coating that has exceptional strength compared to weight. FRA is working with the tank car industry on this project.

Conclusion

Thank you for allowing me to provide this brief update on current research initiatives to improve safety in the railroad industry and on the complex,

technical areas of enhanced track inspection systems, PTC, NDGPS, and railroad equipment safety. I look forward to your comments and questions on these important subjects.

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The Time to Invest in the Nation's Rails Is Now:
Testimony of James Seney
Executive Director
Ohio Rail Development Commission

My name is James Seney. I am Executive Director of the Ohio Rail Development Commission, which is the state agency responsible for passenger rail development, as well as development issues related to freight railroads.

Congressman LaTourette, members of the Committee, thank you for the opportunity to testify on behalf of what I believe is a long-overdue effort to reinvest and redevelop the transportation mode that first spanned a continent and truly made us a nation... our railroads. You and your colleagues should be commended for your efforts in recognizing this critical need within our nation's transportation infrastructure.

Already, you have taken some key and positive steps:

- Putting some of HR 1631's Ride 21 provisions into the SAFETEALU Act, especially increasing RRIF loan funding and eliminating onerous rules which had prevented the Federal Railroad Administration (FRA) from making as many loans as it could have.
- Changing the emphasis of Ride 21 grants from "technology" development to "corridor" development. Getting Americans on board high speed trains in our major rail corridors with the technology we have available now will do far more to drive the need for faster and better technology.
- Recognizing in the Ride-21 language (Section 26106 (a) (3)) that the legislation needs to be more than a mechanism for moving people by stating that Ride-21 funding also needs to ensure that future rail capacity needs must be met for freight as much as for passengers.

Now is the time to be moving toward creation of a funding mechanism that will finally allow states and the federal governments to partner in meeting the increasingly critical challenge of moving more people and freight in the most timely and cost-effective manner. Railroads do that best.

As we have seen, both natural and manmade catastrophes have exposed our overall transportation system as unbalanced and vulnerable to almost total shutdown. But when disaster has struck, as it did recently along our Gulf Coast with Hurricane Katrina, our nation's railroads kept moving. The Norfolk Southern Railroad lost its main line into New Orleans across Lake Ponchatrain, with its tracks washed completely off the long concrete viaduct. But that same line was replaced and back in action in just ten days and ready to move much-needed supplies and

equipment into the stricken area. Amtrak moved every bit of spare equipment it had into New Orleans to assist in the evacuation of hundreds of people.

And yet, we as a nation have no policy that directs the investment of dollars into a national railroad infrastructure that has been forced to shrink at a time when the demand to move people and freight is growing at critical rates. Railroads by themselves are financially hard-pressed to increase capacity on their lines. In Ohio, we have several major rail bottlenecks and rail corridors that once boasted four, five and even six tracks, but are now down to one or two tracks and unable to handle the increasing demand.

The good news is that Ohio has an aggressive, regional plan to redevelop our rail corridors to handle more freight and allow the establishment of a regional passenger rail network of fast, frequent and timely trains. The **Ohio & Lake Erie Regional Rail / Ohio Hub Plan** will be (quite literally) an engine that will drive economic development, encourage new and expanded business and create more and better jobs. The Ohio Hub will also help us better manage our other transportation systems by relieving traffic congestion and encouraging vastly more efficient connections for the movement of people and goods between rail, highways, airports and waterways.

Ohio is a significant distribution location to supply the North American industrial and commercial base. The Ohio Hub Plan will serve to enhance and strengthen that position.

The Ohio Hub Plan will also help improve our air quality, as well as our quality of life, by creating and improving travel options for people, especially over distances of under 500 miles. We can create virtually seamless travel between rail and major international airports in Chicago, Detroit, Toronto, Pittsburgh and Cincinnati, as well as increasing business at Ohio's large airports. The Ohio Hub Plan can connect our citizens with a multi-layered array of sporting and entertainment events, tourist attractions, major universities, hospitals and major centers of commerce.

Ohio is not alone in this planning effort. We are one of 24 states either planning or implementing local and regional rail plans. This isn't just being done as a vision of the future. Our people, from all walks of life and all parts of Ohio, are demanding it.

ORDC has just released the results of a statewide series of public meetings on the Ohio Hub Plan, and what the public told us was stunningly positive. Not only do the business, government and community leaders and individuals who attended these meetings like the plan, they told us loudly and clearly….. "build it now." We have received enthusiastic letters and official resolutions of support from all over Ohio, most recently at a joint appearance by Cleveland Mayor Jane Campbell and this committee's chairman, Ohio Congressman Steve LaTourette.

But our plan and the plans of other states are handicapped by the lack of a federal funding program dedicated to rail infrastructure. I believe House Bill 1631 is the "vehicle" by which we can fill that funding gap and significantly improve our nation's transportation future.

I would also support amending Section 26106 c (6) that "other support of State and local governments" be expanded to clarify that State and local government, and freight railroad investments in rail related infrastructure projects, such as grade separations and grade crossing

eliminations would qualify under this section. Ohio has embarked on a $200-Million dollar grade separation program, which is eliminating many at-grade crossings along corridors that have been designated by the FRA for future high speed rail service. This program is part of Ohio's long-term commitment to reduce congestion, increase safety and develop high speed rail and should be recognized as such for future funding matches.